Popular Astronomy.

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THE ASTRONOMICAL OUTLOOK.

The astronomical outlook is widening.

It is widening in the sense that as a science it is enlisting coöperation the world over. In the nature of the case, its material being accessible to all workers, this science possesses an international character. This fact has long been recognized and important projects have already been carried out through combined labors at widely separated stations. Others are now in progress and, as new and larger problems present themselves, their solution is greatly facilitated through mutual understanding and united effort. Never before has the willingness to merge individual and isolated undertakings with more general and more comprehensive programs been so whole-hearted. The international meetings which were held during the past year have strengthened immeasurably the unity of astronomical interests in both their professional and personal aspects.

It is widening in the sense that this, the oldest of the sciences, is also the first to have caught the imagination of the layman. There is no one of any degree of intelligence at all who does not feel an interest in knowing more about the universe in which he is placed. The appeal of the starry sky is universal. A complete comprehension of the discoveries of the professional astronomer is sometimes conditioned upon certain technicalities, but the general facts of the stars and planets are like an open book to all. The forming of amateur astronomers associations is an indication of this general desire to know the fundamental facts of the cosmos. And from the ranks of the amateurs frequently come recruits for the profession.

It is widening in a literal sense. What advances have been made within recent years in regard to understanding the scale of the universe! A few years ago the distances of the stars of our own stellar system were astonishing. After a time, however, the conception of the "light-year" became incorporated into our thinking and served a most useful purpose in locating our neighbors in space. We were becoming adjusted to the idea that our nearest cosmical neighbor was some light-years away, but almost immediately other neighbors, at constantly increasing distances, were demanding attention. It seemed that surely all would be encompassed when objects one million light-years distant were recognized. But thought is still moving outward. Now those who are in the best position to speak authoritatively are speaking not only of other galaxies but of "Galaxies of Galaxies." The imagination is thus brought to an-

other stage where expansion is needed. And the conquest of the human mind with nature and her secrets continues.

It is widening in a physical sense. Since the first telescope by Galileo the "largest telescope" has many times been constructed. After each such stage there followed a period of rest to be followed, however, by a period of unrest and further experimentation. The giant "40-inch" held sway for its period. It was surpassed—though in a slightly different field, it is true—by the super-giant "100-inch." Men journeyed long distances to see this marvelous and stupendous and perfect machine, and took it for granted that nothing on a larger scale would ever be attempted. But even within the same generation new plans are announced for the construction of a telescope of twice the diameter, of four times the effective surface, of the wonderful 100-inch. The magnitude of this undertaking is bewildering to the average mind. It might be thought impossible were it not for the fact that apparently impossible things have already been accomplished.

The year which is just beginning will, doubtless, contribute greatly to this widening outlook.

THE NATURE OF VARIABLE STARS.

(First Paper)

By PAUL W. MERRILL.

If some astronomical Rip Van Winkle, for example Hipparchus, having gone to sleep two thousand years ago, should awake tonight and glance at the sky, he would not rub his eyes in wonder at the changes, for the ancient constellations would be shining in their familiar aspects. He might soon discover that the earth's axis has undergone a change in direction, but he would be a keen observer if he detected any changes in the stars themselves. This age-long persistence would, however, scarcely be inferred from a brief inspection of the night sky. The twinkling stars look so minute and unsubstantial that an inexperienced beholder might expect one after another to vanish from its place.[1] Is it not strange that these slight flickering sparks should have such a tenacious hold on luminosity that they not only remain visible for hours, but appear, practically without change, night after night for centuries?

But if the enduring constancy of the stars is impressive to the casual and naive observer, it is more profoundly so to the student who has an inkling of their actual nature. Instead of infinitesimal points of light whose beams find their way, with some difficulty, through the earth's unfriendly atmosphere, he visualizes them as giant globes of incandes-

[1] When a meteor darts across the sky is it not a common conception that a fixed star, suddenly eluding the forces which have held it fast, is making a wild dash for liberty, only to be quickly extinguished by its rapid motion?

cent matter pouring forth energy at so terrific a rate as to stagger the imagination. The contrast between the apparent and the real is the most stupendous in all human experience.

This contrast, like other curious properties of the stars such as their extremely small angular diameters and their apparent fixity in the sky, arises from their vast remoteness. The distance to even the nearest fixed star is so great that it entirely transcends all our ordinary experience and is totally impossible for anyone to visualize: it is in all literalness inconceivably great. By building up a sufficiently large unit we can of course express stellar distances in small figures and say, for example, that the distance to the nearest fixed star is only 4¼ light-years, but this is about like explaining to a child the meaning of the word atom by telling him that it is something made up of electrons and protons. Our best method of illustrating considerable distances on the earth's surface is to state the time required to travel by train, e.g., three days from Pasadena to Chicago. This method does not do so well when applied to astronomy but here are the results. To our sun, which is really very, very near, the railway journey would require 200 years and the cost of a one-way ticket would be $2,000,000. To the next nearest star, for the sun is itself a star, would require 55,000,000 years. The calculated fare is to large to mention but the tip to the porter at only twenty-five cents per day would amount to five billion dollars. Probably no professional astronomer will ever feel that he can afford the trip.

An arithmetical bridge from the apparent to the real is furnished by the number by which to multiply the amount of light entering your eye to find the total emitted by a star. It is a difficult bridge to cross, however, as this number is outrageously large. Suppose you are looking at Sirius, the brightest and one of the nearest stars. Taking the distance as 8.8 light years and the diameter of the pupil of your eye as 8 mm, or one-third of an inch (a liberal estimate), then the total light of Sirius is 17 followed by 38 ciphers times as great as the amount entering either eye.

As distributors of energy the stars are incomparable. Even our sun, a minor star cosmically speaking, is freely dispensing energy at a rate which, if reckoned in horse-power, gives the figure 5 followed by 23 ciphers. Very little of this is stopped by the planets (the earth gets one two-billionth part); the remainder travels on into the depths of space. Our sun is only a dwarf star. Some of the giants must radiate 1000 times as much energy, or 5 followed by 26 ciphers horse-power. This incessant outpouring of tremendous quantities of radiant energy at a steady rate calls for a balanced interplay of forces almost inconceivably great. The effective radiating layers near the surface must continually be receiving from somewhere, presumably from the star's interior, supplies of energy exactly equivalent to those emitted. This amounts to 100,000 horse-power, more or less, per square meter of the star's surface. Its regular delivery must be independent of railroad and coal

strikes, decisions of the Interstate Commerce Commission, and repairs to the elevator. Fulfillment of the requirement of regularity is the rule, however, rather than the exception, for the great majority of all stars, including the faint telescopic stars as well as those visible to the naked eye, shine continually with a steady light. The brightness of most stars is either perfectly uniform or so nearly so that any slight variations which may occur have not been detected. This must mean that in general the stars are stabilized bodies whose internal mechanisms are so nicely adjusted that the outflow of visible energy has been maintained at a substantially constant rate over the whole period covered by available records.

There are, however, numerous stars known as variable stars whose light is *not* constant. The changes in brightness are large in some stars and small in others but in nearly all a certain orderliness prevails. The fluctuations in the great majority of cases have remained within fairly well-defined limits, without any apparent tendency toward cumulative alteration, throughout the decades or centuries during which they have been carefully watched. Surprisingly few stars are known to have suffered permanent alterations in light at any time, or to be growing progressively brighter or fainter. In typical variable stars the brightness fluctuates about an average value which remains the same year after year.

The reason that progressive variations are practically unknown is that the period of time covered by astronomical records is too small to allow secular or evolutionary changes to manifest themselves; the history of civilization spans too brief a portion of the life-time of a star. We cannot watch the stars grow old nor do we read in human records any historical account of stellar evolution. What we know about this fascinating subject comes from inference rather than from direct observation. The study of variable stars is important in this connection for in these objects we are privileged to observe within the course of a few days or months changes which in non-variable stars may require thousands upon thousands of years.

Another type of orderliness also prevails in most variable stars which relates to their times of greatest and least brightness. The fluctuations of most variables repeat themselves at equal or nearly equal intervals of time. Such stars are said to be periodic, the average interval between times of maximum brightness being called the period. The observed periods for different stars range from 3¼ hours (XX Cygni) to 950 days (VW Aquilae).[2] Some stars, however, vary *irregularly* between fairly well-defined limits of brightness, and a few vary apparently at random in a totally unpredictable manner. In addition to these are the new or temporary stars which appear occasionally.

According to a classification proposed more than forty years ago by

[2] ε Aurigae has a period of 27 years, but it is an eclipsing star not intrinsically variable.

the late E. C. Pickering, Director of the Harvard College Observatory, there are five types of variable stars as follows:

I. New or temporary stars (Novae).
II. Long-period variables.
III. Irregular variables.
IV. Short-period variables (Cepheids).
V. Eclipsing variables (Algols).

I. *Novae* come to notice through the extremely rapid brightening of previously faint and inconspicuous stars. The suddenness with which they appear, their short life, and the extraordinary type of spectrum they always exhibit are their chief characteristics and have set them apart from all other kinds of variables. Their physical relationship to the general stellar system is a subject of investigation at present.

II. *Long-period variables* are those which have periods longer than 90 days. This lower limit is a natural one as comparatively few variables have periods between 40 and 100 days, both longer and shorter periods being more frequent. The long-period variables are red in color and exhibit enormous changes in brightness, often more than five magnitudes or 100 times. The average period is about 310 days. o Ceti, the first variable discovered, is a typical star in this class.

III. *Irregular variables* have no constant period. Some are totally irregular while others maintain a semblance of a period. Many of them vary slowly through a range of one or two magnitudes. This group is not homogeneous, as stars may be, and are irregular in several different ways.

IV. *Short-period variables* are those with periods less than 40 days. They are characterized by small changes in brightness and by a high degree of regularity in the repetition of the light cycle. δ Cephei is the type star.

V. *Eclipsing variables* are those whose variations may be explained by the occultation of one star by a close companion revolving about it in the same period as that of the light change. The periods of most of these variables lie between one and five days. Algol (β Persei) is the type star.

A more detailed classification which promises to be very useful is that given by Ludendorff in volume 6 of the German "Handbuch der Astrophysik," published in 1928.

LUDENDORFF'S CLASSIFICATION OF VARIABLES.

I. New Stars (Novae).
II. Variables resembling novae.
III. R Coronae.
IV. U Geminorum stars.
V. Long-period variables or Mira stars.
VI. μ Cephei stars.
VII. RV Tauri stars.
VIII. Long-period Cepheids.
IX. Short-period Cepheids.
X. Eclipsing variables or Algol stars.

The definitions of these classes are as follows:

I. *New Stars.* Stars with a single outstanding maximum which is reached by a very rapid rise of several magnitudes from a lower level of brightness. The decline in brightness takes place much more slowly, and may exhibit numerous lower maxima of minor importance. Examples: Nova Persei, No. 2, 1901; Nova Aquilae No. 3, 1918.

II. *Variables Resembling Novae.* Stars which resemble novae in many particulars but differ from them in others. Not a well-defined or homogeneous group. Examples: T Pyxidis, η Carinae.

III. *R Coronae Stars.* Characterized by the fact that they remain for long periods of time at a *constant maximum magnitude.* This normal brightness is subject to interruption at irregular intervals by a sudden decrease followed by a slow irregular recovery. Examples: R Coronae, RY Sagittarii, SU Tauri.

IV. *U Geminorum Stars.* These stars remain most of the time at a constant or nearly *constant minimum brightness.* At irregular intervals the brightness suddenly increases and then falls slowly to nearly its previous value. Examples: U Geminorum, SS Aurigae, SS Cygni.

V. *Long-period Variables.* The variation usually has a range of several magnitudes and takes place in a nearly constant period between 90 and 600 days. Examples: o Ceti (Mira), χ Cygni.

VI. μ *Cephei Stars.* Red stars which vary irregularly through a small range, say 0.5 magnitude. Examples: μ Cephei, ρ Persei.

VII. *RV Tauri Stars.* Variables which usually exhibit a secondary minimum between two principal minima. The light curves are subject to marked changes. Examples: RV Tauri, R Scuti, R Sagittae.

VIII. *Long-period Cepheids.* Periods between 1 day and 45 days. Rather small magnitude range, say 1 magnitude. The light changes cannot be explained by eclipses due to a companion star. Examples: δ Cephei, η Aquilae.

IX. *Short-period Cepheids.* Similar to class VIII but with periods less than 1 day. Examples: RR Lyrae, and most of the variables in the globular star cluster ω Centauri.

X. *Eclipsing Variables.* The observed changes in brightness arise from occultation by a companion star. Examples: β Persei (Algol), β Lyrae, W Ursae Majoris.

The relationship to the Pickering classification is as follows:

Pickering	Ludendorff
I	I
II	V
III	II, III, IV, VI, VII
IV	VIII, IX
V	X

In the recent (1928) "Harvard Catalogue of Long-Period Variable Stars," by Sidney D. Townley, Annie J. Cannon, and Leon Campbell,

which contains 1760 stars, the principal characteristics adopted as criteria in assigning stars to the class of long-period variables are as follows:

1. A variation in a period of fifty days or more, provided the star had not been assigned definitely to another class of variables.

2. A range of variation of at least two and a half magnitudes, except where published observations prevent the inclusion of the star among the long-period variables.

3. A variation of fairly large range, for which observers have stated that the period is probably long.

4. A spectrum of Class Me or Se, generally indicative of long-period variation.

5. A light curve of the R Coronae Borealis, U Geminorum, or RV Tauri type, especially if the variation exceeds one magnitude.

Variable stars have been under observation for more than three hundred years, and have been intensively studied for about sixty years. The resulting accumulation of data concerning these remarkable objects has called forth extensive discussion and speculation, but in spite of this it is for the eclipsing stars only that the underlying cause of the variability is satisfactorily established, and this type is explained by the orbital motion of two revolving stars, neither of which is intrinsically variable. Working hypotheses have, however, been suggested for some of the other types.

The features presented by the different classes of variables are so diverse that each class must be treated separately. The long-period variables, for example, are distinguished by unique and highly characteristic phenomena, and are more conveniently described by themselves than in connection with the other groups.[3] This does not mean necessarily that they are of a nature totally different from all other variables but only that in the present state of knowledge the emphasis is upon the observed differences rather than on hidden similarities.

Of all classes of variables, the long-period stars are the most numerous and the most thoroughly observed. The very extensive data concerning their light variation are due in no small degree to the efficient coöperation of numerous amateur astronomers. Probably more persons have taken part in the determination of the light curves of long-period variables than in any other field of astronomical investigation. But these objects are interesting not only astronomically but from a purely physical standpoint as well. The application of the spectroscope to the analysis of their light has disclosed many remarkable features, some of which have not yet been matched in any light-source studied in the laboratory.

[3] The writer hopes in the near future to prepare a series of articles on long-period variables. The present paper is intended to serve as a general introduction to the series.

Like spectators of a silent and mysterious drama whose plot is fascinatingly difficult to grasp, astronomers have taken a keen delight in observing the behavior of hundreds of variable stars. To watch a tiny red star outshine its companions for a few weeks and then fade to invisibility while the others remain unchanged, is enlivening to the curiosity and the romantic imagination with which the human race is blessed. More searching observations of the light of variable stars serve but to enhance their appeal to man's interest.

From a scientific standpoint the fluctuations of these stars are regarded as notable natural phenomena well worth recording and studying. In recent years, during which astronomy has come into close union with physics and chemistry, the physical changes which take place in variable stars have been considered of great interest, as it is when energy is transformed that we have our opportunities of learning the properties of nature. Unusual transformations or those involving unusual conditions are especially worth investigating. In appraising the value of investigations of variable stars we must remember that much of the common scientific and technical knowledge of to-day lay yesterday in the realm of the remote and obscure. No one can doubt that facts and theories now at the frontiers of scientific exploration will later be brought into the practical service of the world. Mankind would not part with what has been learned about light and electricity in the last fifty years for many, many times what that knowledge cost; but as the essential facts were being developed they doubtless seemed totally disconnected from practical application.

We cannot expect ever to travel to the stars or to make them do our bidding but we may hope to learn from them phases of truth about matter, electricity, light, and gravitation which will profoundly benefit the human race.

CARNEGIE INSTITUTION OF WASHINGTON, MOUNT WILSON OBSERVATORY.

OBSERVATIONS OF VENUS.

By LATIMER J. WILSON.

From May 11 to November 13, 1927, Venus was an interesting object for small telescopes, changing from the phase of a disk about seven-tenths illuminated to a thin crescent and reaching again a nearly half-moon phase on the latter date. Visual observations of Venus were made by the writer in 1911, from March to June, many drawings of the planet being made. Some markings were seen but were enigmatical and so vague that nothing could be decided from them. But this year (1927) an effort was made to photograph the planet with an 11-inch reflecting telescope. There was no lack of brightness to furnish an image

of moderate size, a negative lens being employed to magnify the focal image, arranged in the telescope as described in an article by the writer published in POPULAR ASTRONOMY, "Photographing Jupiter," August-September, 1927.

Each negative contains a number of images, exposures of about one-tenth of a second, made at intervals of from four to six seconds, as Venus passed through the field of view. No slow motion or driving clock was used. Images with varied magnifications range from about one millimeter to one and one-half millimeters in diameter. These were enlarged on lantern slide plates by projection, and contact negatives were made from the positives thus obtained.

Drawings were also made from night to night. Comparison of visual observations and photographs indicates that certain areas of light and shade on the crescent are more conspicuous photographically than can be seen visually. Streaks of semi-darkness extending into the bright part of the crescent from the terminator were first noticed on the photographs. Scrutiny of the disk the next night showed some of them, but much fainter and more vague than the photographs indicated them to be. Since Venus is accredited with an atmosphere, we should expect the light-scattering effect to be such that surface features would be entirely masked in short-wave photographs. The writer's negatives were obtained in blue-violet on plates sensitive to this portion of the spectrum. Hammer's Ultra Rapid Press plates were first employed, but it became apparent that their graininess produced distortions in the markings rendering them more conspicuous but less reliable as compared later with those obtained on fine-grained emulsions. The best negatives are of Cramer Contrast plates, Hammer Slow plates, and Hammer Lantern plates. At least two different brands of plates were exposed when each observation was made. Each brand shows the markings, better seen on the small images than when printed. At best they are so vague in prints that to reproduce them would be hopeless. A violet filter made by flowing the negative lens with a thin coat of gelatine and then dyeing the coating with methyl violet was found better than either blue-green or blue. But some of the negatives obtained with no filter show the markings about as well.

On July 1, photographs gave a hint of unusual roughness near the southern cusp of Venus, suggesting parallel ridges separated by dark streaks. Air-waves passing across the image produced distorted effects, but through these defects there was a suggestion of elevations comparable to those near the south pole of the moon. Visually, this was partly confirmed the next night. Since then it has been amply confirmed by subsequent views, visual and photographic. On July 14, and extending through July 28, these ridges at the rim of the crescent appeared as projections. They were seen again from time to time in October and were remarkably displayed on November 4 when good seeing in daylight prevailed. If these bright areas are clouds they are enormously high and

occupy a fixed location in latitude. If they are mountains they are also of prodigious height.

Visually they presented domes and peaks more rugged in contour than the Leibnitz or Dörfel mountains on the moon. Historical reference shows that Schroeter (1790), LaHire (1700), Beer and Maedler, and numerous others have seen elevations near the southern cusp of Venus and irregularities along the terminator.

Observations were discontinued after August 11, and were begun again when Venus became sufficiently well placed in the morning sky, September 22 being the first observation of the morning star. Such continuous bad weather prevailed after November 13 that no observations beyond that date were made here.

The double-concave lens used for magnifying the image, when properly adjusted, furnished good images over an area in the center of the field. Images entering from the margin of the field are somewhat distorted since they were composed of overlapping spectra, but even on many of the distorted images the markings, also distorted, are found. This seems to indicate clearly that they are actually on the planet and are not effects of graininess. I do not see how they could all be produced by optical defects or incompetence of a small reflector.

Drawings from the prints have been made as faithfully exact as I could make them, copying the indistinct markings with exaggerated intensity. The cusps of the crescent were copied from drawings made at the time of visual observation and within a few minutes of the time of photographing the planet. The negatives do not show them, evidently because of their fineness and lack of light. In the prints the crescent presents a blunted aspect, the amount of bluntness being variable from day to day, and more pronounced in the south than the north. This seems to confirm the presence of high clouds or mountains casting shadows across the southern rim of the crescent. (See Plate II, Frontispiece.)

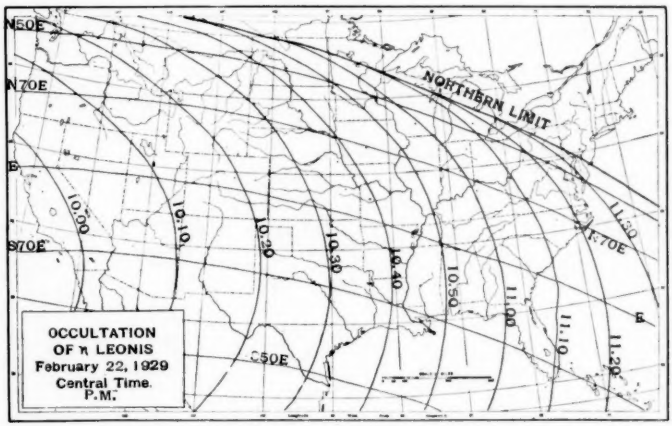
Considering the mysteries which still envelop the planet Venus, other amateur astronomers should systematically study the planet even if their optical equipment is moderate in power. Photographs, though inadequate records from such equipment as mine, do seem to furnish some results to aid in studying the planet.

1405 Gartland Ave, Nashville, Tennessee.

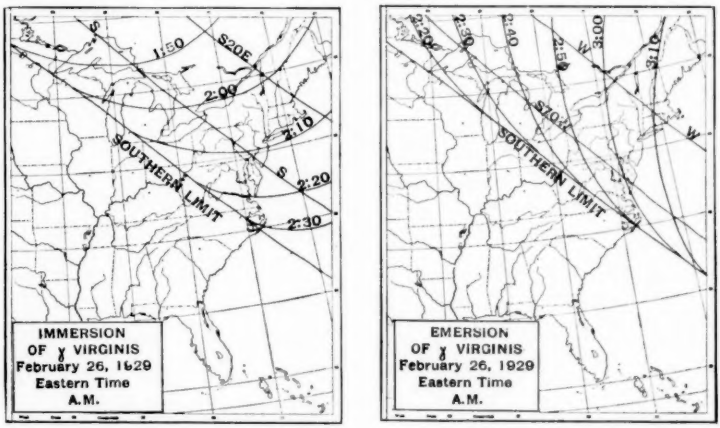
OCCULTATIONS FOR FEBRUARY 1929.

By WM. CLETUS DOYLE.

February 22. η Leonis (3.6 magnitude). The curved lines on the diagram marked from 10:00 o'clock to 11:30 o'clock represent the times of the immersion at ten minute intervals. By interpolating between the lines the time for any place can be found to within a minute or two. The other lines indicate the angular distance of the disappearance from the



north or south point of the moon (e.g., N70E means 70 degrees east of the north point). Along the line marked "northern limit" the star will just graze the edge of the moon. The moon is only thirteen hours before full.



February 26. γ Virginis (about third magnitude). The disappearance will take place on the bright limb of the moon for all except those who live very near the line marked "southern limit." Note that the disappearance takes place approximately at the south point and the reappearance at the west point. The moon is only two and a half days after full phase. This occultation occurs between 1:50 and 3:10 Eastern Standard Time.

CREIGHTON UNIVERSITY OBSERVATORY, OMAHA, NEBRASKA.

AMERICAN ASTRONOMICAL SOCIETY.

(Continued from page 32)

UNIVERSITY OF CALIFORNIA

Berkeley Astronomical Department

STUDENTS' OBSERVATORY

Mr. Crawford exchanged with Mr. Menzel of the Lick Observatory during the second half year. Mr. Crawford investigated the orbit of χ Draconis, developed a method for determining the orbit of a double star for the special case $i = 90°$, and observed the positions of comets and of the satellites of Neptune.

The instruction in astrophysics and in navigation and nautical astronomy has been reorganized with the coöperation of visiting members of the Lick Observatory, the Department of Naval Science and Tactics, and the officers of the Navy on duty at Berkeley. Also, through Mr. Kaster, the department has coöperated in the evening course for volunteers offered by the Naval Reserve Aviation Unit, 41st Bombing Squadron.

The only major addition to the equipment was a 3-inch prismatic transit instrument by Gaertner.

The members of the staff have coöperated in the specifications for an electric clock controlled from the Observatory. This clock has a large seconds dial, affording opportunity for accurate time comparisons. It is mounted on a granite base in a conspicuous place on the campus.

Mr. Einarsson has devoted much time to recasting the instruction in navigation and nautical astronomy, particularly in the preparation of tables. Mr. Shane has been experimenting with a method of determining the intensities of solar lines, which turned out to be unsatisfactory. The problem will be continued by another method. He has also made progress in the investigation of stellar spectra in the ultra-violet and has completed and published an extensive investigation of the carbon stars. Mr. Meyer has continued the measurement and reduction of radial velocity spectrograms secured by him at the Lick Observatory during the preceding year.

Under the direction of Mr. Leuschner, graduate students have derived some extremely valuable orbits of the new comets discovered during the year and of some minor planets discovered at the Yerkes Observatory. Special mention should be made of the work of Messrs L. Berman and F. L. Whipple on Comet *j* 1927 (Schwassmann-Wachmann); on Comet *k* 1927 (Skjellerup) by Messrs. N. U. Mayall, H. G.

Miles, and F. L. Whipple; on Comet *a* 1928 (Reinmuth) by Messrs. L. Berman and F. L. Whipple; on Planet YO 26 by Mrs. Maud W. Makemson, which she identified with (841) Arabella. Mr. Charles H. Smiley developed a new theoretical method of determining the number of solutions in Leuschner's Direct Method of Determining Parabolic Orbits. Miss E. E. Sternberg completed an investigation of the relative motion of the components of Taylor's Comet, 1916 I, and confirmed by astrophysical and gravitational methods the previous conclusion of H. M. Jeffers that no rotation of the two components about a common center of mass is involved.

In coöperation with several graduate students and with Dr. Thiele, Mr. A. O. Leuschner made a complete study of the motion of the Pons-Winnecke comet during its appearance in 1927 and announced preliminary results concerning the relation of comets and minor planets and concerning the supposed gaps in the distribution of the mean motions of minor planets.

Messrs. Crawford and Shane completed the reduction of their observations taken during October and November, 1926, in connection with the "World Longitude Determination." The result showed an increase of one-tenth of a second over the previously adopted longitude of Berkeley. This is consistent with the results obtained at Lick Observatory.

Mr. Kaster has developed a new position finder for the determination, without the use of tables, of the hour angle, latitude, or geographical coördinates of points on the Sumner line at sea and in the air. The description of this instrument aroused considerable interest. The first instrument constructed according to Mr. Kaster's design has been loaned to the Byrd Expedition to the Antarctic. Preliminary tests made by Mr. Kaster show that the performance of the instrument exceeds his most sanguine expectations.

Mr. Leuschner, with the able assistance of Dr. Thiele and Mrs. Maud W. Makemson, has continued the preparation of the research surveys of the minor planets. This work is being supported by an appropriation secured by the National Research Council. 527 surveys with 8000 references and 1700 sets of selected elements are now completed. The completed surveys represent the material on the older planets and are, therefore, by far the greatest part of the total work to be done. The research surveys will contain a complete account of all observational and theoretical work of permanent value which so far has been done on the minor planets. By the elimination from the bibliographical record of all inaccurate and temporary work which includes every approximate orbit, the basic material for further investigation will become available. At present, many investigations are based on spurious data and lead to wrong theoretical conclusions. The first by-products of the survey will be an analysis of the value of different methods of determining perturbations, further evidence of the relationships of minor planets and

comets, and definite conclusions concerning certain problems of stability of motion in the solar system.

At the close of the academic year the total number of graduate students, all candidates or prospective candidates for the Ph.D. degree in Astronomy, in residence either at the Lick Observatory or at Berkeley or temporarily in teaching positions, was 19. In addition, Dr. Dirk Brouwer, a graduate of the University of Leiden, Holland, was engaged in research with Mr. Leuschner on a fellowship supported by the International Education Board. Mr. Brouwer studied the group method of determining perturbations for planets with the mean motion of 550″ and was also engaged in research on problems of stability.

A. O. LEUSCHNER, *Director.*

OBSERVATORIO NACIONAL ARGENTINO

CÓRDOBA, ARGENTINA

(For the year ending December 31, 1927)

The reductions of the measures for the astrographic catalogue were completed for the remaining three degrees, —29°, —30°, and —31°, and the manuscript made ready for the printer. The reduction tables were in preparation and the reductions of the *repére* stars were well under way.

The reductions of the observations for the fundamental catalogue were practically completed for discussion and it is expected to issue it in 1928.

18,793 observations were secured in the last zone of the DM., —62° to —82°. During the year the map of the polar region —82° to —90°, and the last four maps of the zone —42° to —62° were completed. It is hoped to finish both the catalogues and the maps in 1928 for this entire work from —22° to the pole.

24 plates with a small spectrograph attached to the astrographic telescope were secured, mostly of globular clusters.

The time service was maintained as usual.

The mounting for the large reflector was transported to the site in the Sierras and protected from the weather.

C. D. PERRINE, *Director.*

DOMINION OBSERVATORY

OTTAWA, CANADA

Meridian Work and Time Service. Observations were obtained on 175 days, including 2731 star observations, 161 of the sun and planets, and 926 readings of nadir and other constants. A list was distributed giving the times of reception at Ottawa and Vancouver of wireless signals used in the world longitude operations of October-November, 1926.

The time service in government buildings was continued. In addi-

tion to the regular time signals an experimental transmission on short wave is also broadcast from the Observatory at 3:00 P.M. The signals from Annapolis, Bordeaux, Nauen, and Rugby were received regularly by coincidence methods, and those from Annapolis and Bordeaux by automatic registration also.

A new underground clock-vault, with accommodation for four clocks, was completed and put into use.

Solar Physics. Direct photographs of the sun's surface to record sun-spots were obtained on 141 occasions. The number of spectrum observations, of solar limbs, centre and iodine-comparison spectrum, was 414. Over 500 measurements of spectrograms and accompanying reductions were also made. A piece of apparatus consisting of a graduated sphere with a rectangular framework for reading the latitude and longitude of observed points on the sun was designed, and construction was begun in the workshop.

Fifteen-inch Equatorial. Spectrographic work on the brighter Cepheids and some triple systems was continued and 172 spectrograms were obtained. In collaboration with Dr. A. V. Douglas of McGill University a considerable number of spectrograms were analyzed with a Moll microphotometer; curves of variation of line intensities in Cepheids have given interesting results. The photo-electric photometer was put into regular use and 119 observations were secured. The program involves concurrent spectrographic and photometric studies of the same stars. Papers on Nu Eridani and Eta Aquilae were issued as *Publications,* Vol. IX, Nos. 4 and 5.

Photographic Photometry. Observations for magnitudes of comparison stars were completed on 45 fields of the Ottawa list, and over 20 of these fields were measured and reduced. A list of 6 areas covering 19 Cepheid variables was distributed to the coöperating observatories; 170 plates of these areas were made here with the triple two-inch camera equipment. It is expected that in future this work will be carried on under the auspices of Commission No. 27 of the International Astronomical Union.

Seismology. Earthquakes to the number of 353 were registered and the more important reported to the press and by telegraph to Science Service, Washington; monthly bulletins were distributed to 222 stations. The seismographs at Ottawa, Saskatoon, and Halifax were in continuous operation. The short-period Wood-Anderson seismographs were located at Shawinigan Falls and Seven Falls, Que.; their installation was completed and recording is on a regular schedule. The *Bibliographical Bulletin* of the Eastern Section of the Seismological Society of America was prepared and distributed quarterly; up to the end of June one thousand seismological publications were listed. A report on the Quebec earthquake of 1925 was published in the *Transactions* of the Royal Society of Canada.

Terrestrial Magnetism. During the year magnetic work was carried out in accordance with a program which was begun two years previously and had for its object mainly the securing of secular change data over the region already covered by the survey. The three magnetic elements declination, inclination, and horizontal intensity were obtained at 72 stations, 56 of which were occupied previously. The area covered is included between longitudes 78° W and 131° W, and the Canada-United States boundary and latitude 56° N. Results of the observations in 1921, 1922, and 1923 were published as Vol. VIII, No. 8.

Gravity. Gravity determinations were made at 15 stations, of which 6 were in Ontario, 3 in Manitoba, 3 in Saskatchewan, and 3 in British Columbia. Under the title "Gravity in Western Canada," in the *Transactions* of the Royal Society of Canada, isostatic conditions in the western plains and mountains were discussed.

R. Meldrum Stewart, *Director.*

HARVARD COLLEGE OBSERVATORY

Cambridge, Massachusetts

(For year ending October 1, 1928)

The inauguration of formal graduate studies is a significant step in the Observatory's development. Professor H. H. Plaskett has been called to take a major part in the direction of the researches of advanced students and in the instruction in astrophysics. A course in the theory and practice of astronomical observations has been inaugurated with six members of the staff participating in the instruction. Research courses are now offered in the fields of stellar systems, analysis of spectra, stellar statistics, meteors, and photometry.

Good progress has been made on the more important programs, as outlined below.

The construction of residence, offices, garage, and telescope buildings on Harvard Kopje at Bloemfontein is well under way. New mountings for the 10-inch Metcalf and for the 24-inch Bruce telescopes have been shipped. A new Ross lens has been made and tested. Work on the mirror and mounting for the new 60-inch is progressing satisfactorily, and before the end of next year we hope the telescope will be at Bloemfontein.

Mr. Luyten and Mr. Waterfield have gone to South Africa, the former on a fellowship from the Guggenheim Foundation for the study of proper motions.

Dr. Otto Struve, Dr. Alexander Vyssotsky, and Dr. Leon Hufnagel have each spent a part of the year at the Observatory in spectroscopic researches.

Variable Stars. In the investigation of Milky Way variables, four hundred and twenty-two variable stars have been discovered and published. Seventeen Innes variables have also been rediscovered. Most

of these variable stars are of long period, and for a large number of them approximate elements are already determined by Miss Swope, Mr. Luyten, and Mr. Gerasimovič.

Mr. Waterfield has determined the photographic light curves of the eclipsing stars UU Ophiuchi, W Volantis, and T Circini (*H.B.* 852, 853, 855). The light curve of H.V. 4159 was determined by Miss Woods, and the orbit of this star computed by Mrs. Shapley (*H.B.* 854). Mr. Campbell gives the period and visual light curve of the short-period eclipsing star B.D. —20°2009 (*H.B.* 858). A new eclipsing star is announced by Mr. Waterfield (*H.B.* 854), and one with a period of 732 days, or, less probably, of 244 days, has been found by Mr. Luyten (*H.B.* 852).

The *Harvard Catalogue of Long-Period Variables*, compiled by Professor Townley, Miss Cannon, and Mr. Campbell, has been published (*H.A.* 79, No. 3). It is based on the detailed bibliography that has been kept for many years by Miss Cannon, and contains 1769 stars that can be assigned with a certain degree of confidence to the long-period class. For eleven hundred of them the periods are known; for thirty-three per cent spectra have been classified; and for twenty-seven per cent the class of light curve is definitely known. The catalogue is more than a compilation, for it contains classifications by Miss Cannon of all available spectra, and serves for the study of the spectral variations.

Elements have been determined and published for ninety-five long-period variables, in addition to those for stars discovered and announced during the year. They are for the most part the result of a systematic study of plates under the direction of Miss Payne, outlined in *Harvard Reprint* 41.

The relations of period, spectral class, range, and apparent magnitude have been discussed by Miss Cannon and Mr. Campbell on the basis of the new catalogue. The most significant features of the discussion are the relation between period and spectrum, and the frequency curve for period. Spectrum and range, period and range, and period and brightness are not strongly correlated.

The period-spectrum relation for long-period variables is discussed by Mr. Shapley (*H.B.* 861) in its bearing on the relationship that undoubtedly exists between the long-period variables and the Cepheids. The similarities are intrinsic, and their differences are mainly incidental to the conditions that depend on different stages of the same type of phenomenon.

Mr. Gerasimovič, continuing his study of the RV Tauri class, discusses the variations of V Vulpeculae (*H.C.* 321), and the light curve (*H.C.* 323) and changing period (*H.C.* 333) of R Scuti. He notes AR Sagittarii as an undoubted member of the RV Tauri class (*H.B.* 857). The variable Z Ursae Majoris appears to be a star of a type intermediate between the long-period variable and the RV Tauri star,

sometimes displaying the one kind of variation, sometimes the other (*H.B.* 856).

Still more remarkable is the type of variation displayed by UU Herculis, which has two distinct but commensurable periods (*H.B.* 857). Mr. Gerasimovič also finds, in collaboration with Miss Walton, that Z Cancri has three commensurable periods (*H.B.* 862).

Three R Coronae type variables are announced: one was found by Mr. Luyten (*H.B.* 852), and two are described by Miss Payne in *H.B.* 861. According to observations by members of the A.A.V.S.O., the light of R Coronae Borealis has been constant throughout the year, and S Apodis has decreased continuously in brightness.

Of the irregular variables announced, one in the Andromeda nebula is pointed out by Mr. Luyten (*H.B.* 859) to be of absolute magnitude about —7.5, if not a foreground star. TV Andromedae and W Apodis are found respectively by Mr. Gerasimovič and Mr. Waterfield to vary irregularly (*H.B.* 852, 854). FN Sagittarii is found by Miss Payne to resemble a nova of small range (*H.B.* 861). Others, found by Mr. Luyten, are described in *H.B.* 852.

The variations of ϵ Aurigae are discussed by Mr. Shapley. A period of about 355 days is indicated for what appears to be a part of the normal variation of its maximum light of small range (*H.B.* 858).

The usual summaries of observed maxima and minima for long-period variables (*H.C.* 329) and irregular variables (*H.C.* 330) have been published by Mr. Campbell. Predictions for the year (*H.C.* 320) and the regular bimonthly predictions have also been issued.

Nearly 44,000 observations of variable stars have been contributed to the Observatory by more than a hundred observers—thirty-eight per cent more than were received last year. The observations are almost equally divided between the A.A.V.S.O. and the French Variable Star Association.

Proper Motions. The proper motions of eighteen hundred stars, discovered with the blink microscope, have been measured and published by Mr. Luyten. Five hundred of these stars are in front of the Large Magellanic Cloud. The distribution of their motions is striking. There appears to be a number of stars of abnormal velocity in the region.

Dr. Fairfield has published the proper motions of 213 southern stars of Class M (*H.C.* 322). There is no evidence in these data of the existence of any M star of absolute magnitude intermediate between giant and dwarf.

Attention is called by Mr. Luyten to an A star and a B star, both of large proper motion (*H.B.* 852, 858). He also reports on a star of Class K, which has an absolute magnitude of 12.3, and is therefore an extreme dwarf (*H.B.* 861).

The proper motion of Nova Pictoris, measured by Mr. Luyten, is consistent with the absolute magnitude +7 before the outburst (*H.B.* 852).

Meteors and Fireballs. The meteor trails photographed on Harvard plates are under study by Mr. Fisher. The search has important bearings on the problem of meteor photography, indicating that the types of lenses at present in use are not economical for the purpose, and that large field angle and high speed are the important qualities (*H.B.* 852).

Many of the meteor trails showed periodic changes of brightness, and two of them have been studied in detail (*H.Repr.* 40). The observed changes, including the splitting of one of the trails, are interpreted in terms of the dynamics of a spinning projectile in a resisting medium.

Mr. Fisher has made a study of the meteor catalogue of von Niessl and Hoffmeister, and shows that the proportion of hyperbolic velocities of fireballs must be excessive (*H.C.* 331). He has rediscussed the famous meteoric procession of February 9, 1913, and finds that all the observations can for the first time be interpreted satisfactorily by taking into account the diurnal rotation and equatorial bulge of the earth (*H.Repr.* 47).

As a result of a campaign for the reporting of fireball observations it has been possible to discuss the showers of fireballs that took place on August 10 and October 16, 1927. Both seemed to constitute sparse showers (*H.Repr.* 50). Accurate observations of a fireball on August 13, 1927, permitted the determination of the height of disappearance (*H.B.* 853).

The study of the irregularities of apparition of meteor showers, with which Mr. Fisher is concerned, involves the reduction of observations to a standard epoch. He finds (*H.Repr.* 42) that the uncertainty of an approximate formula given by H. A. Newton affects appreciably the results of a previous investigation (*H.Repr.* 35).

Three Leonid meteors, photographed on the same plate in 1898, have been discussed (*H.B.* 857) by Mr. Hogg. No admissible combination of corrections would reduce the radiant to a point, and we appear to have for the first time definite proof of a spread radiant.

Stellar Systems. A re-examination of the distribution and distances of stars and nebulae at the galactic center has been made by Mr. Shapley, with results that essentially verify earlier studies. The galactic longitude and latitude of the center are 327° and 0°, respectively, and the distance from the sun, as derived from the system of globular clusters, is of the order of fifty thousand light years.

In order to explore more thoroughly the region of the galactic center, a concentration of the variable star work has been directed to fields in Scorpio, Ophiuchus, Sagittarius, and neighboring constellations. A preliminary discussion of the hundreds of new variable stars indicates a high concentration of luminous stars at about the same distance as that indicated by the globular clusters for the galactic center.

The distribution throughout sixty degrees of longitude and forty degrees of latitude has been examined for novae, planetary nebulae, dark nebulosity, open clusters, Class B stars, and variables of the Cepheid

and long-period types. Obscuring nebulosity is found to cover a considerable portion of the regions around the center.

The distribution of extra-galactic nebulae in the region of the galactic center is of high importance, in that it shows that some of the star clouds are free of obscuring matter.

Positions have been measured for several thousand of the new nebulae reported last year, and many new faint nebulae have also been found.

Fifteen new clouds of extra-galactic nebulae have been recorded on Bruce plates and are being studied with regard to classification, population, and distance.

Mr. Shapley and Miss Ames have practically completed the investigation of the Coma-Virgo cloud of nebulae. The system apparently lies at a distance of more than ten million light years, is two million light years in diameter, and is composed of nearly three hundred individual systems. The dispersion in apparent magnitude in the cluster is nearly three magnitudes, but its lower limit is difficult to disentangle from the general field of faint nebulae and the other three or four remote clouds of nebulae in Coma-Virgo.

The apparent diameters and ellipticities of ninety-five globular clusters are given by Mr. Shapley and Miss Sawyer in *H.B.* 852. Apparent diameter and integrated photographic magnitude are correlated, especially for systems of similar concentration. These data are to form the basis of a revision of the distances of the clusters.

A number of unpublished investigations have been made on galactic and globular clusters, dealing mainly with star counts, variable stars, distances, and distribution. A catalogue of the magnitudes and colors of several hundred stars in Messier 22 is completed. A survey of all the open galactic clusters has been made on a uniform basis. Some new globular clusters have been added to the list, making the total 103. A special study of the variable stars in the open cluster Messier 4 is in progress. A monograph on star clusters is under preparation by Mr. Shapley.

Spectroscopic Researches. During the year, the fourth installment of the *Henry Draper Extension* was issued, containing the spectra of 4200 stars of the Helsingfors-Gotha A.G. catalogue, $+55°$ to $+59°$, inclusive.

Classifications of 7350 spectra have been made by Miss Cannon for the *Extension*, completing this part of the work in a region of eight hundred square degrees centered at 6^h, $+18°$. The central line of the Milky Way and a portion of the Taurus obscuring cloud are included in the region.

Observations of the spectra in a large region of the sky in Sagittarius and Scorpio are now in progress, to supplement the work on variable stars in the analysis of the galactic center. It is hoped that these spectra will be contained in the next section of the *Henry Draper Extension*.

The laborious work of determining the magnitudes of the stars for

the *Extension* has progressed steadily under the direction of Miss Walton; altogether 42,779 estimates of photographic magnitudes have been made.

Dr. Vyssotsky has photographed and classified a large number of spectra of faint stars. The observations are made with the 24-inch reflector and large objective prism, and classifications are based on Miss Cannon's standards.

The spectroscopic work of the last three years has been continued; a summary of results and procedure is given by Miss Payne and Mr. Hogg (*H.Repr.* 43). Laboratory standardization, and the calibration of unstandardized plates, have been investigated and reported respectively by Dr. Dunham (*H.B.* 853) and by Mr. Hogg (*H.B.* 856).

A short study of line intensities for the important super-giant ϵ Aurigae, and a discussion of the quantitative composition of stellar atmospheres on the basis of photometric line intensities was made by Miss Payne (*H.B.* 855).

The measurement of line width and contour has emerged into importance, and much of the spectroscopic program has been devoted to this problem. Measures for the lines of hydrogen were published by Dr. Dunham (*H.B.* 858), and for those of calcium by Miss Payne (*H.B.* 858), and Mr. Hogg (*H.B.* 859). The use of the measures of line contour in analyzing the atmospheres of the stars quantitatively was discussed by Miss Payne (*H.Repr.* 48), and the results of the analysis were used by Miss Payne and Mr. Hogg (*H.C.* 334) to discuss the pressures in stellar atmospheres on the basis of the Saha ionization formula. The derived pressures are very low, and appear to be related to the gravity at the surfaces of the stars concerned.

The photometry of the continuous background of the spectra of some stars has also received attention. Mr. Gerasimovič finds that the disappearance of the bright lines from the spectrum of μ Centauri was accompanied by a sensible decrease in the brightness of the star. For another B star with bright lines, P Cygni, he has derived the exceedingly low temperature of 7,600° (*H.B.* 857), and he has also observed striking changes in the bright lines of the spectrum of this star (*H.B.* 852). He calls attention to seven additional B stars whose spectra show the bright lines of ionized iron (*H.B.* 851). Another study relating to background photometry was made by Miss Payne in the measurement of the depression of the apparent continuous background of the spectra of some A stars by the wings of the Balmer lines (*H.Repr.* 46). The absorption band at λ 4200, attributed to cyanogen in second type stars, also occurs in early type spectra; but it now appears that glass absorption is principally responsible, and the need of a quantitative investigation of prisms and lenses in all equipment used in spectrophotometry is indicated.

A synopsis of the published material from all known sources on the spectra of comets, and a discussion of the spectral variation as a func-

tion of distance from the sun have been made by Mr. Hogg (*H.Repr.* 57).

Precise spectrophotometric studies of eight nebulae, from plates made at the Dominion Astrophysical Observatory, have been carried on by Mr. Plaskett (*H.C.* 336). The discussion bears on the attribution of the lines in the nebular spectrum, the conditions in the nebulae, and the classification of the spectra of nebulae.

A tentative discussion of possible systems of classifying and relating the spectra of the nebulae and the O stars was put forward by Miss Payne (*H.B.* 855).

An extensive investigation of the intensity of the lines of calcium in the spectra of Class B on Harvard plates was summarized by Dr. Otto Struve (*H.B.* 857). On the basis of estimates on the spectra of seventeen hundred stars he extended and amplified his conclusions derived from the study of the brighter stars at the Yerkes Observatory; the intensities can be used in the estimation of stellar distances and of the absolute magnitudes of stars of Class B.

Spectra and color indices of stars at the north galactic pole are under study by Mr. Shapley and Miss Walton, who find evidence of abnormal blueness for dwarf stars of the second type.

Miscellaneous. Photographic measures of the positions of double stars have been in progress for many years under the direction of Mr. King. The method is described in *H.C.* 332, and results are presented for 435 double stars. Mr. Luyten has published the proper motions of sixteen pairs of double stars with common motion.

The photovisual magnitudes and color indices of bright southern stars, and a revision of the magnitudes of the northern standards have been published by Mr. King (*H.A.* 85, No. 10). The magnitudes are measured by extrafocal methods. The relation between spectral class and color index for giant stars is one of the important results of the discussion.

Ionization by electronic impact in stellar atmospheres has been discussed by Mr. Gerasimovič (*H.B.* 857). He concludes that the quantitative effect of the electron impacts is negligible, but that the effect must occur to some extent, with important consequences for the distribution of atoms among their possible states, and consequently for the appearance of the corresponding spectral lines.

During the year the Observatory has published seventeen *Circulars*, ten *Bulletins* containing eighty-seven notes and articles, and three sections of the *Annals*. Ten papers have been printed in scientific periodicals and included in the Observatory series of reprints. Under the direction of Mr. King, about 4650 plates have been taken at Cambridge with various instruments. At Bloemfontein two photographic telescopes are being operated regularly during the period of construction of the permanent station.

HARLOW SHAPLEY, *Director.*

OBSERVATORIO ASTRONOMICO

UNIVERSIDAD NACIONAL

LA PLATA, ARGENTINA

(July, 1926, to June, 1928)

Personnel. Señor R. Grinfeld resigned in April, 1928, and the post of computer was filled by Señor Martín Dartayet.

Instruments. A collimating lens of 21 cm aperture and 134.6 m focal length was secured from Steinheil and used to install a new meridian mark. A new Riefler clock was mounted in the room with the old one, and this room put under thermostat control, eliminating the annual variation of temperature which had been some 14° C. The meridian circle is now in condition for fundamental work.

In order to change the 80-cm reflector to Cassegrain type for mounting the spectrograph, the principal mirror was sent to Zeiss for cutting a central aperture and to be refigured. Since it was broken in the process a new mirror has been ordered and in the meantime the mounting is being improved in several respects.

A small solar camera, obtaining equivalent focal length of 7.5 m by a Barlow lens, was constructed in the shop and mounted on the 5-inch portable telescope. Several accessory instruments for the seismological service have also been built in the shop.

Researches. The catalogue of Zone B, —57° —62°, is now ready for printing, after a revision which occupied Mr. Dawson for several years and in the course of which some five thousand errors in the original reductions have been corrected. The catalogue of Zone D, —66° —72°, is in preparation and further observations were secured in Zone E, —72° —82°. Observation of the Eros stars was continued by Señor Martínez, so that now no star of the list has less than two observations and most have three.

A determination of the longitude of the Observatory by the reception of wireless time signals was carried out by Dr. Hartmann, the new value being smaller by $1^s.14$ than that previously used. This is of the same order and in the same sense as the differences recently noted at Santiago, La Paz, and elsewhere in South America, and confirms their systematic character.

Considerable attention was devoted to the comets Pons-Winnecke (1927 *c*) and Skjellerup (1927 *k*). A series of 98 observations of the former, 27 of them in the last ten days of June, was secured by Mr. Dawson.

The observation of occultations was made a part of the observing program in May, 1927. Twenty-five were observed by Mr. Dawson with the 17-inch refractor in that year and 15 in the first five months of 1928. Since joining the staff in April, and in addition to his duties as

computer, Señor Dartayet has observed 17 occultations with the 20-cm comet seeker and has also continued with it the observations of variable stars which he had previously been making with his own 10-cm glass.

Nova Pictoris was followed by Dr. Hartmann with the small spectrograph attached to the astrographic telescope. The Nova was also examined visually with the large refractor, showing a disk but no outer ring. A letter to Johannesburg requesting check measures of the diameter of the disk called forth the announcement of duplicity.

Detailed general predictions of the eclipse of 1927 January 3 for the whole Republic were prepared by Mr. Dawson and a party of four went from the Observatory to a point in Neuquén Territory to observe it, determining times of the contacts both visually and photographically.

Under the direction of Dr. Lunkenheimer the seismographs have been made successively more sensitive and records of greater scientific value are now being obtained continuously.

The routine time and meteorological services have been maintained. The Observatory has been visited by an ever increasing number of persons, both on the regular public nights, and in groups from secondary and normal schools.

Publications. During the interval covered by this report there have appeared Vol. XI, part I, of the *Publicaciones*, containing places of the stars in the southern Kapteyn Selected Areas, and *Contribuciones Geofisicas*, Vol. I, No. 3, and Vol. II, Nos. 1 and 2, besides several notes and articles in the *Astronomical Journal*, *Astronomische Nachrichten*, etc. *Publ.* VI, 5, and *Cont. Geof.* II, 3-4, are in press.

BERNHARD H. DAWSON, *Acting Director.*

OBSERVATORIES OF THE UNIVERSITY OF MICHIGAN

ANN ARBOR, MICHIGAN, AND BLOEMFONTEIN, SOUTH AFRICA

Instruction. Twenty courses in Astronomy were offered by the Observatory staff during the year. Miss Gretchen Mullison received the master's degree, and Mr. H. F. Schiefer, the doctor's degree. Miss Hawes, Mrs. McLaughlin, and Miss Seydel were actively engaged in work on their theses for the doctor's degree.

A 3-inch transit was added to the equipment of the astronomical laboratory during the year. Designs for a 15-inch pyrex reflector were completed and construction begun. The optical parts were ordered from J. W. Fecker.

Research. Observations with the two-prism spectrograph attached to the 37½-inch reflector were continued through the year. This two-prism instrument, giving twice the dispersion of the spectrograph previously employed here, has been especially useful in the analysis of structures and structure changes in complex lines of Class Be spectra. A

careful study of the constants of this instrument and of the spark spectrum of Fe-Ti alloy has been made by Mr. Maxwell.

The principal observing program related to stars of Class B, with emission line spectra, north of —20° declination. Intensive observations have been continued on a number of ϕ Persei spectrum variables. A Moll self-registering spectrophotometer has been used with success in the study of spectra of γ Lyrae, β Lyrae, ϕ Persei, f^1 Cygni, and other stars. A second spectroscopic program included the intensive observation of brighter Algol stars.

Studies of velocity curves with especial attention to irregularities due to rotational velocities during partial eclipse have been continued in the cases of Algol, and other stars.

Spectral studies of ϕ Persei, β Persei, δ Cephei, HR 985, b_2 Cygni, ν Cygni, ν Sagittarii, ζ Tauri, α Lyrae, γ Lyrae, β Lyrae, ϵ Aurigae, and other objects were also carried on during the year.

The measurement and reduction of numerous spectrograms of twenty intrinsically brighter stars were continued for the study of changes in wave-length with spectral class over the spectral range of the brighter Cepheids. This is being done to aid in the interpretation of wave-length variations synchronous with the light changes of Cepheid variables.

Those engaged in the spectroscopic observations and investigations were the following: R. H. Curtiss, W. C. Rufus, D. B. McLaughlin, A. D. Maxwell, H. F. Schiefer, Hazel M. Losh, O. L. Dustheimer, Alberta M. Hawes, Laura E. McLaughlin, Frances L. Seydel, N. L. Pierce, and M. B. Stephenson.

The 12-inch refractor, with a Zöllner photometer attached, has been employed by Mr. McLaughlin in the measurement of variable stars, especially of eclipsing binaries, chosen mainly from among those of especially long period and late spectral class.

Numerous observations have been obtained of RS Ari, ϵ Aur, RZ Cnc, RT Leo, RW CrB, TT Her, WZ Oph, AK Her, AD Her, and S Equ. A beginning has been made on W Sct. RX and RY Gem and RU Eri will be added to the program during the coming winter. Other stars observed are RV Tau, TU Aur, RU CrB, W Ser, and TW Peg. The probable error of a single observation calculated from the residuals from the light curve of observations of RZ Cnc and RT Leo at maximum light is $0^m.037$.

Studies of the light curve of R Scuti were carried on by Mr. Curtiss in collaboration with Professor Alter and Mr. Robb.

Contributions. Mr. Curtiss and Mr. Rufus were engaged during the year in the preparation of material for the *Handbuch der Astrophysik*. Various papers of members of the staff were published in current periodicals or presented before scientific societies.

Changes in Staff. At the end of the year Mr. W. J. Williams was added to the staff as instructor when Dr. Schiefer resigned to accept a position at Des Moines University. Professor O. L. Dustheimer was a

visiting member of the Summer Session staff in 1927.

The Lamont Expedition. The southern station has been officially named, "The Lamont-Hussey Observatory." It is supported entirely by Mr. R. P. Lamont. The building with ample office, library and other space was completed in February, 1928. The 56-foot dome and 27-inch Lamont Refractor were then erected and completed for the beginning of a regular observing program on May 9, 1928. Up to September 1, 1928, the total of discoveries of new double stars was 312, including pairs with separations down to 0″.16, and many remeasures of known pairs had been made. These double star results will appear from time to time, in lots of one hundred by each observer, as parts of the Hussey Memorial Volume.

R. H. Curtiss, *Director.*

MOUNT WILSON OBSERVATORY

Carnegie Institution of Washington

Pasadena, California

The maximum of the present cycle of solar activity seems to have been reached during the first half of 1927. The remainder of the year showed a marked decrease, followed early in 1928 by an increase which did not reach the high level of the preceding year. The spectra of sun-spots have been photographed in the near infra-red to a limit much beyond that reached previously. Observations of solar disturbances and fields of force in the sun's atmosphere have been carried on regularly by Hale with the spectrohelioscope, and most valuable results have been obtained from measurements of the radial velocities of the dark and bright prominences rendered visible with this instrument.

A total of 424 groups of sun-spots was observed on 312 days during the calendar year. Polarities were determined for 405 individual groups, of which 394 proved to be regular, and only 11 irregular, in the sign of their magnetic fields.

The revision of Rowland's Table of Solar Spectrum Wave-lengths has been completed by St. John and his associates. In addition to the wave-lengths, upon the International System, of nearly 22000 lines, the table contains a great number of new and revised identifications, and a large amount of physical data relating to the temperature and pressure classification of the lines, their energy-levels and multiplet relationships. The presence of a number of elements not known previously in the sun's atmosphere has been established in the course of this work.

The extension of this table toward longer wave-lengths has been made possible by Babcock's investigation in the infra-red. He has been able to secure negatives showing the principal lines as far as λ 11900. Over 600 new lines have been measured, among them the prominent line of the Ritz-Paschen series of hydrogen at λ 10049.

A calibration of the intensities of solar lines given in Rowland's Table has been carried out by Russell, Adams, and Miss Moore. The resulting tables give a relationship between the relative numbers of atoms active in producing a line and the Rowland intensity, and may be applied to stellar spectra for which the Rowland scale has been used.

In the continuation of his investigation St. John finds that lines of medium level in the solar atmosphere show the displacement in exactly the amount predicted by the relativity theory, while those of higher level show somewhat more, and those of lower level somewhat less. A study of these lines at the sun's limb indicates that the deviations are probably to be ascribed to convection currents in the solar atmosphere.

The results of Pettit's observations of solar radiation at $\lambda 0.32\,\mu$ show a marked parallelism with the curve of sun-spot group numbers. The principal changes in light of the sun as a variable star are in the ultra-violet. Pettit has also measured the ultra-violet radiation of the sky under various conditions of clearness. The amount is found to be surprisingly large even on completely cloudy days.

Dr. Ross completed a series of photographs of Venus in light of different colors. He concludes that the rotation period is less than the orbital period, and that the diameter in ultra-violet light is about 2 per cent greater than in red light; also that the outer atmosphere is composed of a thin stratum of cirrus clouds, while the inner atmosphere is dense, and yellowish in color.

Hubble continued his survey of faint nebulae. He has completed his study of stars in the Andromeda nebula, finding the distance to be about 5 per cent greater than that of Messier 33. The 86 novae observed in the Andromeda nebula indicate a frequency of between 25 and 30 a year, and a restricted range of 3 or 4 magnitudes at maximum. The maximum frequency occurs at photographic magnitude 16.5, or absolute magnitude —5.7 at the distance indicated by the Cepheid variables.

Hubble finds a correlation between exposure time and numbers of nebulae, corresponding approximately to uniform distribution in depth. About 170 nebulae per square degree are found on negatives exposed 2 hours with the 100-inch.

Humason has determined a radial velocity of —130 km/sec for N.G.C. 6822 from measurements of emission lines; a radial velocity of —300 km/sec, and a spectral type of F5n, for N.G.C. 205, the fainter companion of the Andromeda nebula; and a radial velocity of +1500 km/sec for the small spiral nebula, N.G.C. 4884. Merrill has photographed the nebular lines in the red, and his detection of the double character of $\lambda 7325$ confirms Bowen's identification of it.

Van Maanen finds a probable error of $\pm 0''.006$ for the trigonometric parallaxes obtained at the Cassegrain focus of the 60-inch, and $\pm 0''.010$ for those at the primary focus of the 100-inch. Investigating trigonometric parallaxes by different observatories, he concludes that errors

which depend on right ascension are present in all the series.

The completion of the great catalogue of photographic magnitudes of the stars in the Selected Areas is a notable event. Carried on by Seares, with the assistance of Miss Joyner and Miss Richmond, and in coöperation with the Kapteyn Laboratory at Groningen, this investigation has involved the measurement of the photographic magnitudes of about 65000 stars extending to an average limiting magnitude of about 18.5. The final magnitudes show a high degree of accordance with one another and with the scale of the North Polar Sequence, and, in addition to providing numerous standards well distributed over the sky, afford abundant material for several of the problems of stellar distribution.

The 15-foot spectrograph has been used for obtaining the spectra of bright stars on a very large scale, and a new plane-grating spectrograph for the near infra-red region. Many spectrograms of faint stars of large proper motion, variable stars, and faint components of visual binaries have been obtained with the low-dispersion spectrograph.

The relative velocities of the components of the Algol variables X Trianguli and RT Sculptoris have been determined by Joy; the velocity-curves of the Cepheid variables T Monocerotis, U Vulpeculae, and TU Cassiopeiae by Sanford; and the orbits of two spectroscopic binaries, each of which is a component of a visual binary, by Sanford. Radial velocities of +170 km/sec and −390 km/sec have been found by Joy and Adams for the Cepheid variable AG Aurigae and the short-period variable TU Persei, respectively. Sanford's observations of the eclipsing binary RX Herculis have brought the mass of this star into agreement with Eddington's mass-luminosity relationship.

Strömberg finds that among the super-giant stars of types K3-K5 the dispersion in velocity is small. The average peculiar radial velocity of the ordinary giants is 20 km/sec, and the solar motion derived from them is 25 km/sec. There is no trace of Kapteyn's two streams, but the asymmetry in velocity-distribution is very marked.

Joy has determined the velocity-curve of U Sagittae and the absolute dimensions of the system. Absolute dimensions have also been derived by Joy for RT Lacertae and RS Canum Venaticorum, both of which show spectra with double lines.

Merrill has studied the relative intensities of certain pairs of emission lines in the spectra of long-period variables, and finds a progressive change during the whole time within which the lines are present. The behavior of the bright lines, therefore, evidently does not depend solely on the apparent brightness of the photosphere.

Merrill has identified many of the prominent emission lines in the spectra of η Carinae and certain M-type variables as "forbidden" lines of the ionized iron atom. These lines have never been observed in the laboratory. Joy found, in June, 1928, many of the forbidden lines in the spectrum of the irregular variable RT Serpentis, and some remarkable changes in other spectral characteristics. The forbidden lines have also

been observed in the spectra of several B-type stars with bright lines.

Further stellar spectroscopic investigations have included a detailed study of the spectrum of α Persei with high dispersion by Dunham, the classification of the spectra of the separate components of double stars by Leonard, and the continuation of observations of the spectra of faint stars in the Selected Areas by Humason. In α Persei about 1800 lines were measured, more than 90 per cent of which have been identified, and the measurement of their absolute intensities is in progress.

The absolute magnitudes of about 400 stars of types K3 to K8, including both giants and dwarfs, have been determined by Adams, Joy, and Humason by the spectroscopic method. Strömberg has made an investigation of the values for the giants and a determination of their probable errors. Twenty-eight of the stars may be classed as supergiants with a mean absolute magnitude of —1.4. The remaining giants have a magnitude of —0.1 and show a dispersion of 1.3 magnitude.

Special investigations have been made of faint components of stars of large proper motion, and of the Cepheid variables. The results so far obtained for the Cepheids indicate that absolute magnitudes can be derived by an extension of the reduction system employed for ordinary giants of similar spectral type. A close correlation seems to exist between spectral type and absolute magnitude.

Russell and Adams have used the high-dispersion spectrograms of bright stars in an investigation of the amounts of metallic vapor present above stellar photospheres, and of the temperatures and other physical conditions in stellar atmospheres. The results indicate a serious departure from thermodynamic equilibrium in stellar atmospheres, which results in an apparent excess of the number of atoms in excited states. After correction for this anomaly, temperatures are derived, which agree closely with those found by other methods. The amounts of metallic vapor above equal areas of the photosphere of the cooler c-stars like α Orionis seem to be of the order of 100 times as great as in the case of the sun; and the strength of the enhanced lines in such stars suggests that they are produced largely in extensive chromospheres supported by radiation pressure.

The measures of stellar radiation accumulated by Pettit and Nicholson have been completely reduced, and the results applied to the computation of the absolute bolometric magnitudes, temperatures, and diameters of a considerable number of stars. Betelgeuse and Antares are found to have the brightest radiometric magnitudes, followed by Sirius, Canopus, and γ Crucis. Stars of low temperature do not, in general, radiate like black bodies, the deviation in the case of long-period variables amounting to 2.5 mag. in heat-index, and 0.4 mag. in water-cell absorption. Several of these variables at maximum have computed diameters ranging from 0".022 to 0".047. The calculated diameter of Sirius is 0".005, of Procyon, 0".007, and of Capella A,

0″.011.

Measurements of the diameter of Betelgeuse by Pease with the 20-foot interferometer gave a value of 0″.037 for the epoch, February 1928.

In the Physical Laboratory, King has made extensive investigations of the spectra of several of the rare earths. This work has included the measurement of the wave-lengths of several thousand lines, mainly on spectrograms taken with the electric furnace; the separation of the lines of the neutral from those of the ionized element; their temperature classification; and a special study of many of the complex lines, especially of praseodymium, with high dispersion. The ultra-violet spark spectrum of the doubly-ionized atom of each of these elements has also been investigated. Frequent use has been made of the method of suppressing the enhanced lines by introducing into the electric furnace an element like caesium of still lower ionization potential. These investigations have been of great assistance in the identification of rare earths in the solar spectrum.

An analysis of his measurements of the displacements of iron lines under pressure has enabled Babcock to define the change of level of the various spectral terms produced by a difference of one atmosphere in the pressure at the source of light. The Mount Wilson classification of spectral lines has thus been given a numerical basis. A difference of one temperature class in the furnace classification of King corresponds to a change of about 0.7 volt in the excitation potential, except in the case of calcium, where it is 0.35 volt.

Anderson has studied the strong continuous spectrum shown by vacuum tubes through which a heavily condensed discharge is passed. With voltages of 3,000 to 35,000 volts he finds, at a current density of about 20,000 amperes per square centimeter, a sort of "saturation" value beyond which the increase in intensity of the continuous spectrum with current is slight. At current densities less than 10,000 amperes per square centimeter the continuous spectrum is practically absent. These results are for an initial gas pressure of 0.5 mm of mercury in a tube 10 cm long viewed end-on. A promising method is thus afforded for determining the absorption coefficient of gases at high temperatures.

An attempt has been made by Smith to produce in the laboratory the forbidden lines of ionized oxygen and nitrogen found in the spectra of gaseous nebulae. Vacuum tubes of various forms excited in many different ways were tried, but the forbidden lines did not appear.

Pettit's laboratory investigations included the measurement of the radiation of arc lamps in the ultra-violet region $\lambda\,0.29\,\mu$ - $\lambda\,0.31\,\mu$, the optical properties of fused and crystalline quartz, and photochemical changes in glass.

The study of fused quartz lenses shows that a reticulated structure is present, due probably to the fusion surface of the crystals used in their manufacture. In some cases, the chief effect is scattered light in the image, but in others where striae are seen multiple images are produced.

Additional laboratory investigations have included King's work on ultra-violet arc and spark spectra of several elements, the principal neutral and enhanced lines of erbium, and the line and band spectra of boron; Babcock's revision and compilation of standards of wave-length; Smith's successful development of a long-period vertical seismometer; and several studies by Pettit of photochemical changes in the ultra-violet transmission of glass, and the transmission of organic liquids and filters in the ultra-violet or infra-red.

Strömberg and Pease have repeated the experiment of Esclangon, made in 1927, which appeared to indicate the existence of an ether-drift or of a non-isotropic character to space. Their apparatus was mounted on a turntable floating in mercury and was rotated slowly in one direction and then the other. The displacements of the fringes were found to be extremely small, seldom exceeding 0".02, and did not seem to be in any way systematic. Esclangon's values showed an amplitude of 0".05 and varied with the sidereal time.

Attempts to use the 82-mile base-line between Mount Wilson and Mount San Jacinto for measurements of the velocity of light were interfered with so seriously by smoke and haze that Dr. Michelson decided in June to move the distant station to Santiago Peak, about 50 miles from Mount Wilson. Conditions thus far have been unfavorable for observations. In the meantime Dr. Michelson has devised a method for carrying on the measurements in a pipe line exhausted of air, about half a mile in length.

Observations have been continued by Michelson, Pearson, and Pease on the ether-drift experiment, and the apparatus has been used in a variety of forms. Several hundred measures made with the 11-foot rotating steel and invar interferometer showed no displacement of the kind observed by Professor Miller, which varied with sidereal time, but residual disturbances amounting to several hundredths of a fringe were found, which were ascribed to a combination of temperature effects and strains in the interferometer frame. The interferometer was then set up on a 100-inch cast-iron plate floating in an annular tank filled with mercury. The apparatus was enclosed in a double room and observations were made from without. The measurements of Pearson and Pease give a negative result even more decisively than before, and show that the disturbing factors have been almost completely eliminated.

(To be continued.)

EDITOR'S NOTES.

An Acknowledgment. – This word has various shades of meaning. As it appears in Shakespeare, it means: The owning of a benefit received; courteous recognition; an expression of thanks. It is in these senses that it is used here. The editor, in returning again to his desk after an absence of six calendar months, —five issues of this periodical—feels very deeply the need of just this word. As he moved from one astronomical center to another and received in Bologna, in Paris, in Brussels, in London, in New York, copies of the successive issues, the sense of his obligation to those who were doing his work so faithfully constantly increased. During this period, as the readers well know, the affairs of POPULAR ASTRONOMY were carried on uninterruptedly and very efficiently. The responsibility for the magazine was assumed by Professor Edward A. Fath, the associate editor. He was ably assisted by Mrs. Olive M. Hawver, the secretary. It is to these persons that the editor is greatly indebted, and to them he here makes "acknowledgment."

Variable Star Papers. —On page 60 of this issue we are beginning the publication of a series of papers by Dr. Paul W. Merrill, of the Mt. Wilson Observatory staff, on "Variable Stars." In this series the author will present a more or less complete account of this class of objects which recently have assumed such an important place in questions relating to the structure of the stellar universe. This will be done in a style not "too severely technical," to use his phrase, and thus will furnish interesting reading and at the same time supply accurate information to amateurs and professionals. Dr. Merrill, through a careful study of variable stars for a number of years, is well qualified to do this. The second paper, entitled "The Discovery of Long-Period Variable Stars" is already in hand and will appear in the near future. Others will follow from time to time until the series of nine papers is complete. We are greatly pleased to be able to present this series to our readers.

A Recognition of the Work of Amateur Astronomers.— One of the interesting and significant developments in astronomical work in recent years is the enthusiasm of the so-called amateur astronomers. In many centers, groups of persons having this common interest have been united into Associations. The largest of these is the Amateur Astronomers Association in New York City, with headquarters at the American Museum of Natural History. The membership of this association now numbers well along toward one thousand. In some lines of astronomical investigation, such as variable stars, meteors, eclipses, occultations, these amateurs, with little or even with no astronomical equipment, can and are accumulating data which are useful and will increase in importance as time goes on. In fact the word "amateur" is merely the opposite of the word "professional," and does not in itself imply that the work done by amateurs is inferior.

Reports from this class of workers are being received at the office of POPULAR ASTRONOMY in ever increasing numbers. It has, therefore, been decided that a section of the magazine each month is to be devoted to communications of this kind. These pages will thus serve as a means for the interchange of ideas on the part of the non-professionals, a sort of clearing-house for astronomical projects, methods, and results.

It is hoped that from time to time we may have brief accounts also of the activities and programs of the Associations as well as items relating to individuals. For this purpose the assistance of the secretaries of the several associations is needed and is hereby requested.

Pages 112-114 of this issue inaugurate this new department under the heading "Notes from Amateurs."

PLANET NOTES FOR MARCH.

By CLIFFORD E. SMITH.

The *Sun* will be moving northeast from the eastern edge of Aquarius to the central part of Pisces. Early on March 21, G.C.T., it will cross the equator, which marks the beginning of spring. The position of the sun on March 1 and March 31 will be, respectively, R.A. $22^h\ 46^m$, Decl. $-7°\ 51'$; and R.A. $0^h\ 36^m$, Decl. $+3°\ 53'$.

The phases of the *Moon* will occur as follows:

Last Quarter	March	3 at 5 A.M.	C.S.T.
New Moon		11 " 3 A.M.	"
First Quarter		18 " 2 A.M.	"
Full Moon		25 " 2 A.M.	"

The moon will be at apogee (farthest from the earth) on March 4, and at perigee (nearest the earth) on March 17.

Mercury will be moving eastward across the central part of Aquarius. On March 9 it will be in conjunction with the moon. On March 5 it will be at greatest elongation west, and on this date Mercury will rise about an hour and a half before the sun.

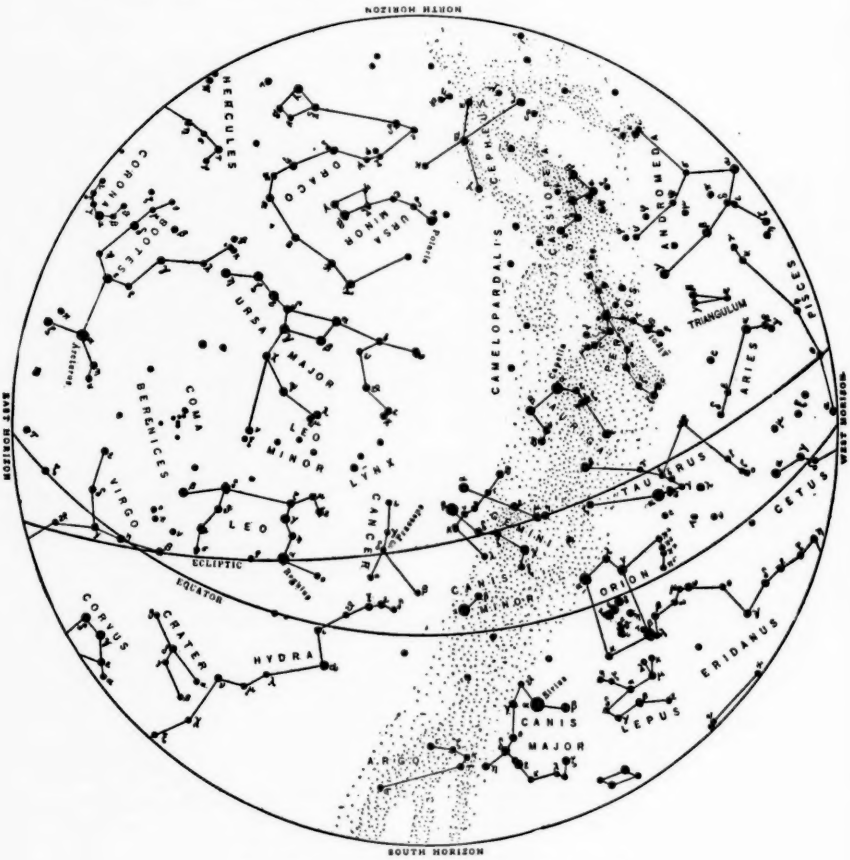
Venus will be moving eastward most of the month from the central part of Pisces to the central part of Aries. On March 29, however, it will begin a period of retrograde motion. On March 2 Venus will pass through its perihelion position. On March 14 it will be in conjunction with the moon, and on March 15 it will be at its greatest brilliancy. During the middle of the month it will set about two and a half hours after the sun.

Mars will be in the western part of Gemini, and its apparent motion will be slowly eastward. On March 18 it will be in conjunction with the moon, and will be distant from the moon's limb about the apparent diameter of the moon. On March 28 Mars will be in quadrature east of the sun and thus will be on the meridian about sunset.

Jupiter will be in the central part of Aries. Its apparent motion among the stars will be direct or eastward. On March 14 it will be in conjunction with the moon, and it will be distant only a few minutes of arc from the moon's limb. During the middle of the month Jupiter will set about three hours after the sun.

Saturn will be in the western part of Sagittarius, and its apparent motion will be direct. On March 4 it will be in conjunction with the moon, but it will not be particularly close. On March 21 it will be in quadrature west of the sun and thus, during the latter part of the month, it will be near the meridian at sunrise.

Uranus will be in conjunction with the sun on March 28, and thus its apparent position will be near that of the sun during the month. Uranus consequently will be invisible during March.



THE CONSTELLATIONS AT 9:00 P.M. MARCH 1.

Neptune will be in Leo about a degree from Regulus. On March 22 it will be in conjunction with the moon, but it will not be very close to the moon. During the middle of the month it will be near the meridian about ten-thirty Standard Time.

Occultations Visible at Washington.

[From the *American Ephemeris.*]

Date 1929		Star's Name	Magnitude	IMMERSION. Washington C.T.	Angle from N	EMERSION. Washington C.T.	Angle from N	Duration
				h m	°	h m	°	h m
Mar. 3	126	P. Scorpii	6.1	2 0	163	2 48	246	0 47
16	72	Tauri	5.4	17 24	40	18 32	284	1 9
16	284	B. Tauri	6.0	22 4	60	22 57	288	0 53
17	125	Tauri	5.1	22 54	28	23 20	336	0 26
18		Mars	0.8	10 42	109	11 25	232	0 43
21	57	B. Leonis	6.5	22 8	58	22 44	2	0 37
22	46	Leonis	5.8	18 23	173	18 56	231	0 33
25	46	Virginis	6.1	19 2	138	19 58	281	0 56
25	48	Virginis	6.5	20 45	101	21 49	329	1 4
29	150	B. Librae	6.1	1 12	165	2 12	260	1 0

Monthly Report of the American Association of Variable Star Observers, for the Month Ending December 31, 1928.

A grand total of 2401 observations on 397 variables by 37 different observers is a splendid record for any month, and especially so for December, when inclement weather usually prevails. This is due to several favorable conditions, perseverance on the part of a selected few, being doubtless the main cause.

SU Tauri, 054319, reported last month as rapidly dropping to minimum, is, according to latest advices, well up to normal maximum brightness again. The decrease in brightness was of the order of a magnitude a week, and the increase was practically the same. If this variable behaves as it has been wont to do in the past, it will probably undergo another, and more protracted, drop within a year.

The Occultation Department of the Association is doing excellent work, not only in the matter of observations, but in the computations. Mr. Yalden, the Chairman of the Occultation Committee, will be pleased to hear from any and all who desire to take a part in this fascinating side issue. Especially does this apply to those members with mathematical ability, and who, for one reason or another, have little time for actual variable star observing. While variable star observing is our main purpose, circumstances often do prevent members from observing, and some of these members might, with profit to themselves and the Association, aid in the matter of these much needed occultations and computations. The ability to handle logarithms and to follow detailed instructions are the principal requirements for this line of work.

By this time new revised charts for some 150 regions should be in the hands of our active observers. If they are not, kindly notify the Chart Curator, Harvard Observatory, Cambridge, Massachusetts, and they will be supplied with promptness. President Pickering spent a week at Cambridge early in December assisting in the distribution of these charts and incidentally gave the Observatory staff and the Bond Astronomical Club the benefit of seeing his splendid collection of slides illustrating the two summer meetings in Europe.

Variable Star Observations Received During December, 1928.

Oct. 0 = J.D. 2425520; Nov. 0 = J.D. 2425551; Dec. 0 = J.D. 2425581.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
V Scl	R And	T Phe	Z Cet	R Ari	o Cet
000339	001838	*002546*	*010102*	021024	*021403*
528 9.9 Bl	550 7.2 Ch	540 10.5 Sm	563 9.8 B	563 10.6 B	586 7.2 Wd
538 9.7 Bl	552 7.3 Ah	542 10.4 Dr	564 10.0 Pt	571 10.2 Ah	586 6.0 Pt
549 9.7 Bl	556 7.5 Ah	549 9.0 Bl	U Scl	580 9.8 Wy	587 6.5 Jo
S Scl	557 7.4 Ah	552 9.4 Dr	*010630*	586 9.0 Pt	588 6.5 Rw
001032	562 7.1 Sw	564 9.2 Dr	531[13.2 Bl	W And	591 7.2 Wd
523 7.0 Ht	563 7.2 Pt	564 9.3 Dw	U And	021143a	596 7.0 Rw
525 7.5 En	566 7.6 Ah	569 9.1 Dr	010940	557 12.9 Ch	S Per
525 7.3 Sm	568 7.6 Ah	W Scl	562[13.5 Lg	586 12.6 Pt	021558
528 6.4 Bl	568 8.5 Gb	*002833*	UZ And	595[13.0 Bw	539 10.0 Kl
531 6.8 Ht	570 7.7 Ah	531 12.9 Bl	011041	T Per	560 9.3 Ch
534 6.7 Sm	571 7.7 Ah	552 13.2 Dr	586 11.1 Bw	021258	562 9.4 Wy
538 6.3 Bl	572 7.7 Ah	569 13.0 Dr	S Cas	552 8.4 Ch	563 9.3 B
540 6.5 Sm	582 8.0 Sb	Y Cep	011272	560 8.3 Ch	580 9.3 Wy
541 6.7 En	586 7.8 Wd	003179	560 10.3 Wy	582 9.0 Wy	586 8.9 Pt
542 6.5 Dr	589 8.4 Sb	569 11.8 Sf	564 9.3 Pt	586 8.3 Pt	R Cet
549 6.3 Bl	596 8.9 Sb	583 12.7 Sf	571 10.2 Sb	o Cet	*022000*
550 6.8 Ht	S Tuc	595[13.0 Bw	585 10.3 Wy	*021403*	552 9.2 Ch
552 6.6 Dr	*001862*	U Cas	587 10.4 Sb	524 3.8 En	RR Per
556 6.5 Dr	525 10.0 En	004047	595 10.8 Sb	527 3.8 Be	022150
564 6.8 Dr	526 9.3 Sm	561 9.5 Wk	U Psc	530 4.1 An	552 12.4 Ch
564 7.0 Dw	528 9.6 Bl	563 9.1 Pt	011712	537 4.6 Wf	563 12.3 B
569 7.0 Dr	532 9.9 En	586 11.0 Bw	564 11.1 Pt	539 5.3 An	586 13.0 Bw
X And	534 9.2 Sm	587 10.2 Sb	570 11.3 Lg	540 4.6 Wf	596 13.1 Bw
001046	538 9.3 Bl	592 11.3 Kz	583 11.4 Lg	541 4.6 En	R For
532 12.1 Bf	540 9.2 Sm	595 11.4 Sb	583 12.0 Sf	542 4.1 Sm	*022426*
550 12.8 Bg	549 9.5 Bl	599 12.2 Bw	592 12.2 Sf	547 4.4 Ch	528 11.2 Bl
553 12.9 Ch	S Cet	RW And	R Psc	552 5.1 Ah	531 11.3 Bl
586 13.2 Bw	*001009*	004132	012502	554 5.0 Ch	538 10.8 Bl
T Cet	553 13.8 Ch	553 12.6 Ch	532[14.2 Bf	555 5.3 Wf	549 9.8 Bl
001620	555 13.5 L	V And	557 13.0 Ch	555 4.9 L	U Cet
530 6.4 An	567 12.2 L	004435	RU And	556 5.2 Ah	*022813*
555 6.6 L	573 12.7 Lg	532 11.2 Bf	013238	557 5.1 Ah	552 9.0 Ch
567 6.7 L	577 11.8 L	550 11.7 Bg	553[13.0 Ch	557 5.3 Ch	571 9.9 Sb
574 6.5 L	581 11.5 An	X Scl	562 12.9 Lg	559 5.4 Wf	586 10.8 Pt
581 6.5 Gt	581 11.4 Gt	*004435*	564 12.5 Pt	560 5.4 Ch	587 10.8 Sb
581 6.7 An	582 10.9 Lg	528 11.9 Bl	Y And	561 5.5 Wf	595 11.4 Sb
T And	583 11.4 Sf	538 12.1 Bl	013338	561 5.4 Lg	RR Cep
001726	592 10.9 Sf	RR And	553[13.0 Ch	562 5.5 Lg	022980
550 9.2 Ch	T Scl	004533	X Cas	563 5.6 Lg	555 11.7 L
557 9.2 Wk	*002438a*	532[14.8 Bf	014958	565 5.7 Lg	562 11.3 L
563 9.2 Pt	552 10.6 Dr	550[12.7 Bg	560 12.8 Bn	566 5.6 Ah	569 11.3 Sf
571 9.3 Ch	556 10.1 Dr	569[13.5 Lg	564 12.6 Pt	567 5.7 L	571 10.6 L
586 10.7 Wd	564 9.7 Dr	— Cas	U Per	568 5.7 Ah	579 10.2 L
590 10.4 Kz	564 9.8 Dw	004746b	015254	569 5.6 Lg	583 10.6 Sf
T Cas	569 9.7 Dr	563 10.7 Pt	560 10.1 Ch	570 5.7 Lg	586 11.0 Pt
001755	RR Scl	W Cas	563 9.7 B	571 5.7 Lg	R Tri
497 7.8 Wk	*002438b*	004958	581 9.7 Wy	571 5.9 Ah	023133
555 9.4 L	552 13.0 Dr	564 8.2 Pt	586 9.1 Pt	572 6.1 Ah	562 10.8 Sw
560 9.6 Ch	569 12.8 Dr	575 9.2 Bw	586 9.6 Bw	572 5.7 Lg	566 11.0 Sf
560 11.1 Wy	T Phe	580 8.5 B	599 9.3 Bw	573 5.8 Lg	566 10.7 Ah
561 10.6 Wk	*002546*	586 9.2 Bw	XX Per	573 5.8 Wd	571 10.6 Ah
563 10.0 Pt	525 12.2 En	U Tuc	015654	574 5.8 L	572 11.2 B
567 9.9 L	526 12.2 Sm	*005475*	560 8.0 Ch	581 6.9 An	583 11.4 Sf
574 10.7 L	528 11.9 Bl	524[12.9 En	R Ari	582 6.5 Lg	586 10.9 Pt
580 9.7 B	532 12.2 En	531 14.4 Bl	021024	583 6.7 Lg	592 11.5 Sf
580 11.4 Wy	534 11.3 Sm	534[12.9 Sm	551 10.4 Ch	586 7.0 Lg	592 11.7 Kz
592 11.4 Kz	538 11.1 Bl		560 10.6 Wy	586 6.6 Sc	

Variable Star Observations Received During December, 1928.

J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

W Per
024356
560 10.7 Ch
562 10.9 Wy
563 10.4 B
586 10.4 Pt
587 11.1 Wy

R Hor
025050
523 13.0 Ht
525 12.8 En
531 13.0 Bl
531 12.9 Ht
532 12.8 En
541 12.8 En
550 12.9 Ht
552 12.7 Dr
556 12.7 Dr
564 12.5 Dr
564 12.3 Dw
565 12.4 Dw
567 12.5 Dr

T Hor
025751
526 12.2 Sm
531 12.9 Bl

U Ari
030514
532 12.8 Bf
557 13.1 Ch
583[13.1 Sf

X Cet
031401
554 9.7 L
559 9.5 Wy
562 9.4 Wy
563 9.2 B
567 9.0 L
574 8.9 L
580 8.9 Wy
581 9.3 Gt
581 9.3 An
582 8.7 Wy
586 8.8 Pt
591 9.2 Bw
592 8.7 Kz

Y Per
032043
560 9.0 Ch
572 9.1 B
582 9.5 Wy
586 8.8 Pt
592 9.7 Kz

R Per
032335
560 10.0 Wy
562 9.9 Wy
563 9.4 B
563 9.7 Lg
572 9.2 Lg

R Per
032335
582 8.9 Lg
586 8.5 Pt
587 9.1 Wy
592 8.8 Kz
595 8.5 Bw

T For
032528
554 9.4 L
562 9.4 L
570 9.4 L
577 9.5 L

U Eri
034625
542 9.6 Dr
552 8.9 Dr
556 8.8 Dr
564 8.9 Dr
565 9.0 Dw
569 9.1 Dr

T Eri
035124
564 12.7 Dr
565 12.5 Dw

W Eri
040725
552 11.9 Dr
556 11.9 Dr
564 11.6 Dr
565 11.6 Dw
569 11.6 Dr

R Tau
042209
532 8.7 Bf
555 9.0 Ch
586 9.2 Pt
587 9.7 Sp
589 8.8 B

W Tau
042215
582 10.7 Wy
586 10.4 Pt
587 10.7 Sp
587 11.2 Gi
589 10.6 B

S Tau
042309
532 13.4 Bf
589[13.0 B

T Cam
043065
555 10.3 L
560 10.2 Ch
560 10.3 Wy
561 11.2 Wk
563 10.4 Wy
567 10.7 L
572 10.4 Lg
574 11.5 L

T Cam
043065
582 11.9 Lg
586 11.6 Pt
587 11.9 Wy

RX Tau
043208
571 10.5 Sc
583 10.8 Sf
586 10.8 Sc
586 10.8 Pt
589 10.7 B
592 11.2 Sf

R Ret
043263
523 7.6 Ht
524 7.4 En
525 7.8 Sm
528 7.8 Bl
531 7.5 Ht
537 7.8 Sm
538 7.8 Bl
541 7.6 En
542 7.6 Sm
542 7.6 Dr
549 8.1 Bl
550 8.7 Ht
552 8.0 Dr
556 8.1 Dr
564 8.5 Dr
565 9.1 Dw
569 9.1 Dr

X Cam
043274
554 8.0 Br
555 8.2 Ch
560 8.3 Br
560 8.8 Wy
561 8.7 Wk
561 8.4 Br
563 8.6 Wy
574 10.6 Br
576 10.8 Br
579 11.2 Br
581 11.4 Br
586 11.8 Pt
587 12.1 Wy

R Dor
043562
523 5.6 Ht
524 5.5 En
525 5.2 Sm
528 5.3 Bl
531 5.5 Ht
537 5.2 Sm
538 5.4 Bl
541 5.6 En
542 5.2 Sm
549 5.2 Bl
550 5.6 Ht

R Dor
043562
552 5.0 Dr
556 5.0 Dr
564 5.2 Dr
565 5.3 Dw
569 5.2 Dr

R Cae
043738
531 10.9 Ht
531 10.7 Bl
534 10.9 Sm
538 10.9 Bl
542 10.6 Dr
549 10.9 Bl
551 11.3 Ht
552 10.9 Dr
564 11.5 Dr
565 11.5 Dw
569 11.6 Dr

R Pic
044349
526 9.0 En
531 8.9 Bl
531 9.3 Ht
534 9.0 Sm
538 9.5 Bl
542 9.2 Sm
542 9.4 Dr
549 9.5 Bl
550 9.7 Ht
552 9.4 Dr
564 9.4 Dr
565 9.5 Dw

V Tau
044617
557 12.0 Ch
572 9.8 Lg
582 10.1 Lg
582 9.8 Wy
586 9.2 Pt
589 9.3 B

R Ori
045307
564 12.1 Dr
587 10.1 Sp
589 10.0 B

R Lep
045514
554 6.7 L
555 7.4 Ch
562 6.6 L
572 6.9 L
586 6.0 Pt
587 7.6 Sc

V Ori
050003
557 12.4 Ch
562 12.5 L
586 12.5 Pt

T Lep
050022
531 11.2 Bl
532 11.7 Bf
538 11.0 Bl
549 10.4 Bl
549 10.4 Bf
586 9.4 Pt

S Pic
050848
526 9.3 En
531 8.6 Bl
534 9.4 Sm
538 9.6 Bl
540 9.4 Sm
549 9.7 Bl
549 9.9 En

R Aur
050953
563 12.0 Wy
566 11.1 Sw
586 10.0 Pt
587 10.8 Wy

T Pic
051247
531[13.6 Bl
551[13.1 Ht
569 12.6 Dr

Nov Tau
051316
554 13.1 L
565 13.2 L
572 13.1 L
572 10.7 L
575 11.8 L
577 9.7 Pt
579 11.1 L
580 11.9 L
581 11.1 L
581 11.2 B
583 11.2 Wy
586 10.6 Pt
587 10.6 Pt
587 11.0 Sp
587 11.1 Gi
589 10.5 Pt
591 10.5 Pt

AN Ori
053005t
552 11.7 L
554 11.7 L
555 11.6 L
556 11.8 L
557 11.7 L
558 11.6 L
561 11.9 L
562 11.4 L
565 11.6 L
566 11.8 L

W Aur
052036
579 11.7 L
583 11.5 Sf
586 11.9 Pt
589 11.0 B

S Ori
052404
586 12.4 Pt
587 12.3 Wy
589 11.7 B

T Ori
053005a
539 10.1 An
552 10.2 L
554 10.2 L
555 10.2 L
556 10.0 L
557 10.3 L
558 10.2 L
561 11.5 L
562 11.4 L
565 10.1 L
566 10.3 L
567 11.1 L
568 10.8 L
569 11.6 L
570 11.5 L
571 10.7 L
571 10.1 Sc
572 10.2 An
572 10.2 Gt
572 9.7 Pt
572 10.7 L
574 11.4 L
575 11.8 L
577 9.7 Pt
579 11.1 L
580 11.9 L
581 11.1 L
581 11.2 B
583 11.2 Wy
586 10.6 Pt
587 10.6 Pt
587 11.0 Sp
587 11.1 Gi
589 10.5 Pt
591 10.5 Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
AN ORI	SU TAU	U ORI	X AUR	X MON	L_2 PUP
053005t	054319	054920a	060450	*065208*	*071044*
567 11.8 L	577 13.0 Pt	561 6.8 Fd	560 9.0 Ch	555 8.0 L	552 3.7 Dr
568 11.8 L	579 12.9 L	566 6.9 Ah	580 9.0 B	556 8.3 Ch	557 3.7 Dr
569 11.8 L	580 13.1 L	568 7.0 Ah	586 9.6 Sc	562 7.9 L	564 3.9 Dr
570 11.8 L	581 13.3 L	568 7.2 Fd	586 8.9 Pt	572 8.2 L	569 3.9 Dr
571 11.6 L	581 12.7 B	569 7.0 Fd	V AUR	574 8.6 Br	RR MON
572 11.8 L	583[12.7 Sf	571 6.9 Ah	061647	580 8.1 L	071201
574 11.7 L	586 12.5 Pt	571 6.8 Sc	554 11.4 L	R LYN	557[13.0 Ch
575 11.8 L	587 12.3 Pt	572 7.1 Ah	557 11.1 L	065355	573[10.6 Gi
579 11.8 L	587[12.0 Sf	572 7.3 Fd	568 11.5 L	552 9.8 Ah	587 10.6 Bw
580 11.7 L	589 12.3 Pt	573 6.6 Wd	571 11.7 L	566 10.1 Ah	V GEM
581 11.8 L	590 12.3 Pt	575 7.4 Fd	574 11.5 L	V CMI	071713
S CAM	591 12.4 Pt	586 6.6 Pt	582 11.5 Lg	070109	571 11.2 Ah
053068	S COL	586 7.1 Sc	V MON	556 9.3 Ch	573 11.2 Gi
561 10.7 Wk	*054331*	586 6.6 Wd	*061702*	562 9.4 Lg	587 10.0 Bw
586 9.0 Pt	526 11.6 En	588 7.5 Rw	556 7.8 Ch	586 10.9 Sf	S CMI
587 9.7 Wy	531 11.1 Bl	588 7.5 Gb	586 8.7 Pt	586 10.7 Sc	072708
RR TAU	534 11.2 Sm	591 6.8 Wd	591 9.0 Wd	R GEM	555 7.2 Ch
053326	538 10.5 Bl	596 7.5 Rw	AG AUR	070122a	569 7.2 Fd
549 12.0 Bf	549 9.4 Bl	V CAM	062047	556 8.5 Ah	571 7.0 Fd
589 13.3 B	551 9.8 Ht	054974	552 10.7 L	557 8.3 Ah	575 7.5 Fd
RU AUR	Z TAU	567 11.1 B	554 10.1 L	562 7.8 Sw	586 7.5 Sc
053337	054615a	569 11.3 Sf	557 10.3 L	566 7.7 Sw	586 7.1 Pt
582[14.0 Lg	532 14.2 Bf	583 11.1 Sf	562 9.8 L	568 7.9 Ah	T CMI
587[13.4 Gi	549[13.5 Bf	586 11.3 Pt	565 9.9 L	570 7.8 Ch	072811
U AUR	583 13.4 Sf	Z AUR	568 9.9 L	571 7.6 Ah	586 11.2 Pt
053531	RU TAU	055353	574 9.7 L	572 7.7 Ah	Z PUP
557 12.9 Ch	054615c	554 10.3 Br	580 9.3 L	573 7.9 Wd	*072820b*
583 12.4 Sf	532 12.9 Bf	554 10.4 Ch	R MON	586 8.0 Wd	532[13.6 Bf
586 12.2 Pt	549 13.7 Bf	560 10.2 Br	063308	586 7.0 Pt	549[13.7 Bf
589 11.5 B	R COL	561 10.1 Br	586 10.8 Pt	589 7.5 Sp	S VOL
SU TAU	*054629*	563 9.7 Pt	NOV PIC	591 7.8 Wd	*073173*
054319	531[13.0 Bl	564 9.7 Pt	*063462*	Z GEM	531[13.2 Bl
539 9.2 An	534[12.4 Sm	567 9.9 B	528 7.2 En	070122b	534[11.4 Sm
552 9.5 L	538[12.4 Bl	571 9.7 Pt	531 7.4 Ht	586 12.5 Pt	540[12.2 Sm
554 9.5 L	551[12.4 Ht	572 9.9 Pt	532 7.2 En	TW GEM	542 13.4 Dr
554 9.8 Ch	552 13.0 Dr	573 10.0 Pt	534 7.5 Sm	070122c	551[12.8 Ht
555 9.5 L	556 12.8 Dr	575 10.0 Br	537 7.5 Sm	586 8.0 Pt	569 13.2 Dr
556 9.6 L	564 12.0 Dr	577 9.8 Pt	541 7.3 En	R CMI	U CMI
557 9.6 L	565 12.1 Dw	581 10.1 Br	542 7.3 Sm	070310	073508
558 9.7 L	569 11.6 Dr	582 9.8 Pt	550 7.3 Ht	555 8.4 L	555 9.8 L
559 10.0 L	α ORI	583 9.9 Pt	S LYN	562 8.4 L	562 10.1 L
561 9.9 L	054907	585 10.0 Wy	063558	562 8.6 Lg	572 10.7 L
562 10.5 L	553 0.6 L	586 9.8 Pt	556[11.9 Ch	572 8.6 L	580 10.8 L
564 10.8 Sf	555 0.6 L	587 9.8 Pt	573 13.2 Gi	580 8.8 L	586 11.2 Pt
565 11.0 L	557 0.5 L	589 9.9 Pt	583 13.8 Sf	586 9.3 Sc	S GEM
566 11.0 L	562 0.4 L	590 10.0 Pt	586 14.2 Pt	R VOL	073723
567 11.4 L	565 0.6 L	591 10.0 Pt	X GEM	*070772*	557[12.4 Ch
567 11.2 B	568 0.4 L	R OCT	064030	534 11.5 Sm	571 13.0 Gi
568 11.7 L	569 0.6 L	*055686*	559 8.2 Bn	540 11.3 Sm	587[13.6 Gi
569 11.5 L	572 0.4 L	524[12.0 En	568 8.3 Bn	542 10.5 Dr	W PUP
569 11.6 Sf	575 0.6 L	531 11.7 Bl	587 8.7 Bw	551 11.3 Ht	*074241*
570 11.8 L	U ORI	537 11.6 Sm	587 9.4 Sp	552 10.6 Dr	531 9.8 Bl
571 11.8 L	054920a	538 11.7 Bl	W MON	557 11.5 Dr	538 9.5 Bl
572 12.1 L	552 6.5 Ah	542 11.8 Dr	*064707*	564 11.4 Dr	549 8.5 Bl
572 11.9 An	556 6.8 Ah	569 12.1 Dr	586 9.9 Pt	565 11.8 Dw	T GEM
572 11.7 Gt	556 6.6 Ch	X AUR	X MON	L_2 PUP	074323
574 12.2 L	557 6.7 Ah	060450	*065208*	*071044*	491[13.6 Bw
575 12.5 L	558 6.5 Fd	554 9.0 Ch	554 8.3 Br	542 3.5 Dr	557 13.2 Ch

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
T GEM	RX UMA	Z VEL	S LEO	T UMA	U OCT
074323	090567	*094953*	110506	123160	*131283*
571[11.2 Ah	554 11.2 L	531 11.5 Bl	572 9.6 Ch	570 9.0 Ah	552 9.3 Dr
U PUP	562 11.5 L	545 11.7 Dr	577 9.8 Pt	571 9.1 Ch	567 9.9 Dr
075612	572 11.5 L	556 11.8 Dr	RY CAR	571 8.9 Kl	R HYA
491 12.3 Bw	580 11.4 L	564 12.2 Dr	*111561*	571 9.0 Ah	*132422*
R CNC	RW CAR	V LEO	528[10.1 Bl	572 8.9 Ah	568 5.4 L
081112	*091868*	095421	557[13.2 Dr	589 7.3 Pt	571 5.5 Ch
557 11.4 Ch	531 9.6 Bl	577 12.7 Pt	RS CEN	R VIR	575 5.0 L
586 11.3 Pt	538 9.6 Bl	RV CAR	*111661*	123307	581 5.4 L
V CNC	545 9.7 Dr	*095563*	527 8.1 Bl	589 9.1 Pt	589 5.4 Pt
081617	549 10.0 Bl	531[13.1 Bl	534 8.3 Bl	RS UMA	RV CEN
554 8.0 Br	552 10.1 Dr	S CAR	557 9.2 Dr	123459	*133155*
560 8.3 Br	556 10.2 Dr	*100661*	559 10.2 Dr	561 9.0 Wk	527 9.0 Bl
571 9.0 Ch	565 11.0 Dw	531 6.0 Bl	564 10.0 Dr	571 10.5 Ch	534 8.9 Bl
575 8.9 Br	569 10.9 Dr	538 6.0 Bl	X CEN	586 11.3 Pt	548 8.9 Bl
576 9.0 Br	Y VEL	549 6.7 Bl	*114441*	S UMA	557 8.8 Dr
586 9.3 Pt	*092551*	552 6.9 Dr	557 10.7 Dr	123961	569 9.1 Dr
RT HYA	531[13.3 Bl	556 7.2 Dr	564 10.5 Dr	523 11.8 An	T CEN
082405	569[13.2 Dr	564 8.2 Dr	569 9.8 Dr	535 11.8 An	*133633*
589 8.3 Pt	R CAR	569 8.5 Dr	W CEN	552 10.8 Lj	537 6.0 Bl
R CHA	*092962*	Z CAR	*115058*	555 10.4 Lj	R CVN
082476	531 9.1 Bl	*101058*	528 11.9 Bl	557 10.3 Lj	134440
531[13.0 Bl	538 9.1 Bl	531 12.6 Bl	R COM	559 10.6 Kl	589 11.5 Pt
534[12.4 Sm	545 8.8 Dr	552 11.1 Dr	115919	561 9.4 Wk	T APS
540[11.8 Sm	549 8.9 Bl	557 10.8 Dr	572[12.5 Ch	565 9.5 Kl	*134677*
U CNC	552 8.6 Dr	564 10.4 Dr	SU VIR	566 9.0 Ah	525[12.3 En
083019	556 8.5 Dr	AF CAR	120012	567 9.7 Lj	529 13.4 Bl
491[13.5 Bw	564 8.1 Dr	*101058b*	572 12.2 Ch	568 9.4 Lj	534[13.2 Sm
X UMA	565 8.4 Dw	552 11.6 Dr	R CRV	568 9.0 Ah	RR VIR
083350	569 7.5 Dr	557 11.7 Dr	*121418*	570 8.8 Ah	*135008*
589 12.8 Pt	X HYA	564 11.7 Dr	561 11.7 L	571 8.8 Ah	589 12.8 Pt
S HYA	*093014*	W VEL	567 11.6 L	571 8.9 Ch	RU HYA
084803	532 10.9 Bf	*101153*	574 11.6 L	571 9.1 Kl	*140528*
571 10.0 Ch	549 11.2 Bf	531[13.0 Bl	580 11.4 L	572 8.7 Ah	537 8.6 Bl
589 10.9 Pt	571[12.0 Ch	U HYA	SS VIR	572 8.7 An	R CEN
T HYA	Y DRA	*103212*	*122001*	572 8.7 Gt	*140959*
085008	093178	552 4.9 L	554 6.6 L	575 8.8 Lj	523 10.5 Ht
555 8.3 L	495 7.9 Bw	555 5.0 L	565 6.5 L	589 8.6 Pt	523 10.2 En
562 8.5 L	R LMI	565 5.2 L	567 7.5 L	RU VIR	525 10.3 Sm
571 9.2 Ch	093934	570 5.0 L	574 7.2 L	124204	527 10.1 Bl
572 9.3 L	571 12.0 Ch	579 4.8 L	581 7.3 L	589 9.5 Pt	531 10.6 Ht
580 9.2 L	572 12.2 Pt	R UMA	T CVN	U VIR	532 10.2 En
589 9.5 Pt	RR HYA	103769	122532	124606	533 10.3 Sm
T CNC	*094023*	561 11.8 Sw	577 9.7 Pt	589 11.0 Pt	534 10.0 Bl
085120	545 13.0 Dr	571 11.5 Pt	Y VIR	U OCT	539 10.3 Sm
571 9.0 Ch	557 13.5 Dr	572 13.2 Ch	*122803*	*131283*	542 10.4 Dr
589 7.9 Pt	564 13.5 Dr	577 13.2 Pt	555 11.5 L	523 9.0 Ht	548 10.0 Bl
V UMA	569 14.0 Dr	V HYA	567 11.9 L	524 9.0 En	550 10.5 Dr
090151	R LEO	*104620*	574 12.8 L	525 8.8 Sm	555 10.2 Dw
555 10.2 L	094211	552 7.2 L	U CEN	527 8.5 Bl	U UMI
562 10.4 L	557 7.0 Ah	565 6.9 L	*122854*	531 9.0 Ht	141567
572 10.7 L	568 7.1 Ah	571 8.0 Ch	528[12.4 Bl	534 8.8 Bl	552 9.6 Lj
580 10.8 L	571 7.6 Ah	572 7.4 L	T UMA	534 8.7 Sm	552 9.4 Ah
W CNC	571 8.2 Ch	577 6.8 Pt	123160	540 8.8 Sm	555 9.5 Lj
090425	577 7.3 Pt	581 7.2 L	539 10.1 Kl	541 9.1 Fn	556 9.6 Ah
555 13.8 L	Y HYA	W LEO	561 10.0 Wk	542 8.7 Dr	557 9.5 Lj
562 13.8 L	*094622*	*104814*	565 9.3 Kl	548 9.0 Bl	566 9.7 Ah
572 14.0 L	577 6.5 Pt	549[13.3 Bf	566 9.4 Ah	550 9.2 Ht	567 10.2 Lj
		572[13.2 Ch	568 9.2 Ah	550 9.2 En	569 10.1 Lj

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J.D.Est.Obs.

U UMi
141567
570 9.7 Ah
571 9.7 Ah
571 10.3 Lj
577 10.4 Lj
589 10.2 Pt
S Boo
141954
521 10.0 An
535 10.9 An
557 12.0 L
567 12.5 L
574 12.5 L
589 12.5 Pt
V Boo
142530a
491 7.8 Rj
492 7.8 Rj
494 7.9 Rj
495 7.8 Rj
496 7.8 Rj
497 7.9 Rj
498 7.9 Rj
503 7.8 Rj
504 8.0 Rj
521 8.3 An
535 8.6 An
589 10.8 Pt
R Boo
143227
552 8.6 Lj
555 8.7 Lj
557 8.7 Lj
568 9.9 Lj
575 10.2 Lj
589 11.3 Pt
Y Lup
145254
523 11.1 En
525 11.3 Sm
527 11.1 Bl
534 11.1 Bl
537 11.9 Sm
543 11.3 Dr
548 11.6 Bl
555 12.0 Dw
S Aps
145071
523[13.4 Ht
525[13.2 Sm
529[13.4 Bl
531[13.4 Ht
534[13.4 Bl
537[12.5 Sm
550[13.2 En
551[13.4 Ht
S Ser
151714
525 8.3 An

S Ser
151714
538 8.7 An
S CrB
151731
526 8.8 Wk
549 6.6 Ch
560 6.2 Ch
563 6.3 Pt
589 6.3 Pt
RS Lib
151822
523 11.2 Ht
524 11.2 En
526 10.8 Sm
529 10.4 Bl
531 10.8 Ht
537 9.7 Bl
R Nor
152849
523 11.5 En
525 11.5 Sm
527 11.2 Bl
532 11.5 En
534 11.3 Bl
534 11.7 Sm
540 11.7 Sm
543 11.6 Dr
548 11.3 Bl
550 11.8 Dr
X Lib
153020
537[12.0 Bl
S UMi
153378
552 8.8 Lj
555 8.8 Lj
557 8.7 Lj
563 8.3 Pt
567 8.8 Lj
569 8.5 Lg
571 8.9 Lj
577 9.0 Lj
586 8.9 Sf
589 8.6 Pt
U Lib
153620a
537 10.4 Bl
T Nor
153654
523 11.9 Ht
523 11.7 En
531 12.6 Ht
543 12.6 Dr
R CrB
154428
523 5.9 An
525 5.9 An
526 6.0 Wk
527 6.0 Be

R CrB
154428
534 6.0 Be
534 5.9 An
538 6.1 An
539 6.0 Be
539 6.2 Kl
549 6.2 Ch
552 6.0 Ah
552 6.2 Lj
553 6.1 L
554 6.1 L
555 6.2 Ch
555 6.2 Lj
556 5.9 Ah
557 6.2 Lj
558 6.2 Lj
559 5.8 Kl
566 6.1 Ah
567 6.0 L
567 6.2 Lj
568 6.2 Lj
570 6.0 L
571 6.1 L
571 6.2 Lj
571 6.2 Sb
573 6.1 Sp
574 6.1 Pt
574 6.0 L
575 6.1 L
575 6.2 Lj
576 6.2 Lj
577 6.2 Lj
577 6.1 Pt
581 6.1 L
583 6.2 Pt
586 6.1 Pt
589 6.2 Pt
590 6.2 Pt
X CrB
154536
589 9.5 Pt
R Ser
154615
589 8.4 Pt
V CrB
154639
589 7.9 Pt
R Lup
154736
523 9.8 En
543 10.1 Dr
RZ Sco
155823
523 9.1 Ht
524 9.1 En
525 9.5 Sm
527 9.0 Bl
531 9.3 Ht
531 9.1 En
533 9.1 Sm
537 8.5 Bl
539 9.3 Sm
548 8.7 Bl
U Ser
160210
525 13.0 An
538[12.3 An
X Sco
160221a
529 11.1 Bl
537 11.1 Bl
SX Her
160325
556 8.0 L
567 7.8 L
573 7.9 L
574 8.0 Pt
577 8.0 Pt
580 8.0 L
583 8.0 Pt
589 7.9 Pt
590 7.9 Pt
W Sco
160519
529[12.0 Bl
RU Her
160625a
556 10.4 L
567 10.2 L
573 10.6 L
589 11.6 Pt
R Sco
161122a
523[12.6 Ht
527[13.3 Bf
S Sco
161122b
523[12.6 Ht
524[12.2 En
527[13.3 Bf
529[13.0 Bl
531[12.6 Ht
W CrB
161138
563 9.0 Pt
U Her
162119
539 8.2 Kl

RZ Sco
155823
540 10.0 Sm
Z Sco
160021
523 9.5 Ht
524 9.1 En
525 9.5 Sm
527 9.0 Bl
531 9.3 Ht
531 9.1 En
533 9.1 Sm
537 8.5 Bl
539 9.3 Sm
548 8.7 Bl
U Ser
160210
525 13.0 An
538[12.3 An
X Sco
160221a
529 11.1 Bl
537 11.1 Bl
SX Her
160325
556 8.0 L
567 7.8 L
573 7.9 L
574 8.0 Pt
577 8.0 Pt
580 8.0 L
583 8.0 Pt
589 7.9 Pt
590 7.9 Pt
W Sco
160519
529[12.0 Bl
RU Her
160625a
556 10.4 L
567 10.2 L
573 10.6 L
589 11.6 Pt
R Sco
161122a
523[12.6 Ht
527[13.3 Bf
S Sco
161122b
523[12.6 Ht
524[12.2 En
527[13.3 Bf
529[13.0 Bl
531[12.6 Ht
W CrB
161138
563 9.0 Pt
U Her
162119
539 8.2 Kl

U Her
162119
552 8.2 Ah
555 8.0 Ch
556 8.2 Ah
559 8.8 Kl
563 8.0 Pt
565 8.4 Kl
566 8.5 Ah
577 8.4 Ah
SS Her
162807
522[12.4 An
538 12.4 An
553 10.1 L
567 9.1 L
T Oph
162815
529[12.0 Bl
S Oph
162816
529[12.6 Bl
W Her
163137
563 13.0 Pt
R Dra
163266
526 9.3 Wk
549 8.7 Ch
552 8.8 Lj
556 8.2 Ah
557 8.3 Ah
557 8.2 Lj
560 7.9 Ch
563 7.8 Pt
566 7.5 Ah
567 7.6 Lj
568 7.5 Ah
570 7.4 Ah
571 7.3 Ah
571 7.4 Lj
572 7.3 Ah
576 7.2 Lj
591 7.1 Sc
RR Oph
164319
527 14.0 Bf
545[12.8 Bf
S Her
164715
552 8.0 Ah
556 8.0 Ah
557 8.0 Ah
560 8.3 Ch
561 8.5 Wy
563 7.4 Pt
566 8.0 Ah
571 8.3 Ah

RS Sco
164844
523 7.2 Ht
523 7.2 En
525 7.1 Sm
527 7.1 Bl
531 7.3 Ht
531 7.3 En
533 7.2 Sm
534 7.3 Bl
534 7.3 En
540 7.5 Sm
542 7.5 Dr
548 7.3 Bl
550 7.6 Dr
550 7.6 En
550 7.7 Ht
555 7.5 Dw
564 8.0 Dr
RR Sco
165030a
523 9.3 Ht
524 9.4 En
525 8.9 Sm
527 8.8 Bl
531 8.8 Ht
532 9.2 En
533 8.4 Sm
537 8.5 Bl
539 8.1 Sm
542 7.6 Dr
548 8.0 Bl
550 7.5 Dr
550 7.7 Ht
555 7.6 Dw
564 7.3 Dr
RV Her
165631
527[13.4 An
538[12.7 An
RT Sco
165636
529[14.0 Bl
R Oph
170215
554 8.4 Ch
RW Sco
170833
527 11.3 Bl
537 11.3 Bl
548 11.5 Bl
Z Oph
171401
552 9.1 Ah
556 9.2 Ah
557 9.1 Ah
561 8.5 Wy
566 9.3 Sp
566 9.1 Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING DECEMBER, 1928.

J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
RS HER	**R PAV**	**RV SGR**	**R SCT**	**RX LYR**	**RS LYR**
171723	*180863*	*182133*	*184205*	185032	190933a
563 9.5 Pt	553 13.1 Dw	550 10.3 Dr	553 5.6 Ch	559[13.0 Ch	559 13.8 Ch
S OCT	555 13.0 Dw	553 10.9 Dw	555 5.9 Lj	S CRA	RU LYR
172486	555 13.0 Dr	555 10.8 Dw	556 5.7 L	*185437a*	190941
523 11.3 Ht	T HER	564 11.5 Dw	557 5.9 Lj	527 11.9 Bl	565 11.0 Lg
524 11.1 En	180531	564 11.1 Dr	558 5.9 Lj	529 12.2 Bl	582 9.9 Lg
526 12.1 Sm	491 8.1 Rj	SV HER	561 6.0 An	534 12.0 Bl	582 10.5 Pt
527 11.5 Bl	492 8.1 Rj	182224	561 6.2 Lg	537 12.2 Bl	U DRA
531 11.8 Ht	494 7.4 Rj	522 13.4 An	562 6.4 Lg	548 12.8 Bl	190967
534 12.0 Bl	495 7.4 Rj	556 10.1 L	563 6.4 Lg	ST SGR	559 12.2 Ch
537 12.8 Sm	496 7.4 Rj	565 9.5 L	564 5.9 Lg	*185512a*	582 11.6 Pt
550 12.3 Ht	497 7.4 Rj	573 9.4 L	565 5.8 L	553 13.0 Ch	W AQL
553 12.6 Dw	498 7.3 Rj	582 9.7 Pt	565 6.5 Lg	553 12.8 L	*191007*
564 13.1 Dw	503 7.2 Rj	T SER	566 5.8 Sp	574[13.0 L	559 13.2 Ch
564 13.1 Dr	504 7.4 Rj	182306	567 5.9 Lg	R CRA	T SGR
RU OPH	516 8.2 Rj	582 11.7 Pt	567 6.1 L	*185537a*	*191017*
172809	522 8.3 An	X OPH	569 6.0 Lj	527 10.5 Bl	553 8.3 Ch
527 12.1 An	522 8.4 Be	183308	569 6.4 Lg	529 10.5 Bl	559 8.2 Ch
538 12.3 An	526 8.5 Wk	491 6.5 Rj	570 6.2 Lg	534 10.7 Bl	582 8.5 Pt
RT SER	535 8.9 An	492 6.5 Rj	571 6.2 Lg	537 10.6 Bl	R SGR
173212	552 9.7 Ah	494 6.6 Rj	571 6.0 Lj	548 12.7 Bl	*191019*
568 12.5 L	556 10.0 Ah	496 6.5 Rj	572 6.3 Lg	T CRA	553 11.5 Ch
RU SCO	559 10.6 Ch	497 6.6 Rj	572 6.0 L	*185537b*	559 10.9 Ch
173543	565 11.6 L	504 6.5 Rj	573 6.3 Lg	529[13.0 Bl	582 10.2 Pt
527 8.7 Bl	566 11.5 Ah	525 7.0 An	573 5.9 Sp	Z LYR	RY SGR
537 8.7 Bl	573 12.2 L	538 7.2 An	574 5.8 Pt	185634	*191033*
548 9.1 Bl	W DRA	556 7.2 L	576 6.0 Wd	554 13.1 L	523 6.1 Ht
SV SCO	180565	565 7.3 L	577 5.9 Lj	564 13.0 L	523 6.3 En
174135	571 10.1 Sc	573 7.4 L	580 6.0 An	572 13.0 L	525 5.8 An
527 10.6 Bl	582 10.2 Pt	582 7.7 Pt	580 5.9 L	580 12.5 L	527 6.0 Bl
537 10.6 Bl	586 10.2 Sc	RS DRA	581 6.0 Gt	RT LYR	531 6.5 Ht
548 11.1 Bl	X DRA	184074	582 6.3 Lg	185737	531 6.3 En
W PAV	180666	560 10.6 Br	582 5.8 Pt	559[13.3 Ch	534 6.0 Bl
174162	571[11.0 Sc	576 10.7 Dr	583 6.4 Lg	R AQL	534 6.5 Sm
523[13.0 Ht	RV HER	581 10.6 Dr	583 5.9 Pt	190108	537 6.5 Sm
529[13.5 Bl	181031	R SCT	586 5.8 Pt	566 11.8 Ah	538 6.1 An
550[13.0 Ht	553 13.7 L	*184205*	586 6.4 Lg	582 11.8 Pt	541 6.5 En
U ARA	556 13.8 L	491 5.6 Rj	587 5.5 Sp	RX SGR	542 6.9 Dr
174551	565 14.2 L	492 5.8 Rj	587 5.5 Pt	*190818*	542 6.5 Sm
524[12.3 En	573[14.5 L	494 5.8 Rj	589 5.5 Pt	523 12.0 En	548 6.3 Bl
534[12.3 Sm	W LYR	495 6.0 Rj	590 5.5 Pt	559 12.8 Ch	550 6.5 Ht
540[12.3 Sm	181136	496 6.1 Rj	591 5.5 Pt	RW SGR	550 7.0 Dr
RT OPH	508 11.3 Wk	497 6.1 Rj	591 5.8 Gb	*190819a*	550 6.5 En
175111	522 10.2 Be	498 6.0 Rj	NOV AQL	523 9.6 En	552 7.0 Dr
582 10.0 Pt	522 10.2 An	503 6.0 Rj	184300	531 9.6 En	553 7.1 Dw
RY HER	526 8.6 Wk	504 6.1 Rj	559 10.5 Ch	553 9.8 Ch	554 6.8 L
175519	535 9.3 An	521 5.1 An	561 10.9 Lg	559 9.8 Ch	555 7.0 Dw
551 11.7 Ch	562 8.6 Sw	522 5.2 An	562 10.9 Lg	582 9.8 Pt	556 6.8 L
559 12.8 Ch	572 8.3 Gt	522 5.2 Be	563 11.0 Lg	TY AQL	556 7.0 Dr
582 13.5 Pt	572 8.4 An	523 5.2 An	565 10.8 Lg	*190907*	557 6.5 L
V DRA	573 8.0 B	525 5.1 An	570 11.1 Lg	582 10.4 Pt	559 6.0 Ch
175654	582 7.9 Pt	527 5.1 An	571 10.9 Lg	S LYR	564 6.6 Dr
582 11.1 Pt	591 8.0 Gb	527 5.0 Be	572 10.7 Lg	190925	564 6.6 Dw
R PAV	RV SGR	530 5.3 An	573 10.7 Lg	553[15.0 L	565 6.5 L
180863	*182133*	534 5.3 An	582 11.6 Pt	568[14.5 L	567 6.5 L
523 12.3 Ht	527 9.1 Bl	538 5.5 An	583 10.8 Lg	X LYR	568 6.5 L
524 12.0 En	537 9.7 Bl	539 5.4 Be	586 11.5 Pt	190926	570 5.7 L
531[12.3 Ht	542 9.8 Dr	550 5.6 Ch		582 9.0 Pt	571 6.4 L
550[12.3 Ht	548 10.4 Bl	552 5.8 Lj			572 6.5 L

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J.D.Est.Obs.

RY SGR
191033
573 6.8 L
574 6.5 L
578 6.5 L
578 6.6 L

TV SGR
191124
523|12.1 En
529|13.0 Bl
555|14.5 Dw

S SGR
191319a
527 11.5 Bl
537 12.0 Bl

SW SGR
191331
529 13.4 Bl
537 13.3 Bl

TZ CYG
191350
582 10.5 Pt
587 10.5 Sp

U LYR
191637
582 10.5 Pt

AF CYG
192745
560 7.2 Br
561 7.2 Br
568 7.2 Br
579 7.3 Br
581 7.3 Br

TY CYG
192928
553|12.9 Ch

RT AQL
193311
553 8.0 Ch
561 8.4 Lg
572 8.9 B
573 8.7 Lg
582 8.7 Lg
582 8.4 Pt

R CYG
193449
553 13.2 Ch
564 13.4 Pt
571|13.1 Sb
595 13.2 Sb

RV AQL
193509
561 10.0 Lg
564 10.1 Pt
573 9.8 Lg
582 9.6 Lg

T PAV
193972
523 8.7 Ht
524 8.9 En

J.D.Est.Obs.

T PAV
193972
528 8.8 Bl
531 9.2 Ht
531 9.2 En
534 9.2 Sm
538 9.3 Bl
540 9.5 Sm
542 9.7 Dr
548 9.9 Bl
550 10.7 En
550 10.1 Ht
552 10.2 Dr
553 9.6 Dw
556 10.4 Dr
564 10.7 Dr
564 10.9 Dw

RT CYG
194048
552 7.2 Ah
553 6.6 Ch
556 6.9 Ah
557 6.9 Ah
564 7.2 Pt
566 7.0 Ah
568 7.2 Ah
571 7.1 Ah
571 6.7 Sc
586 7.4 Sc
587 7.9 Jo
591 7.4 Sc

TU CYG
194348
553|13.4 Ch

X AQL
194604
564 8.4 Pt

χ CYG
194632
525 11.3 An
535 11.6 An
559 12.2 Ch
564 12.2 Pt
571 10.2 B
572 12.8 An
572 12.8 Gt
573 13.0 B

S PAV
194659
524 8.7 En
531 8.7 En
552 8.6 Dr
553 8.5 Dw
555 8.5 Dw
564 8.5 Dw
564 8.7 Dr

RR SGR
194929
527 11.0 Bl
538 11.4 Bl

J.D.Est.Obs.

RR SGR
194929
548 11.5 Bl
552 12.0 Dr
555 12.5 Dw
564 13.0 Dw
564 13.1 Dr

RU SGR
195142
523 11.7 Ht
523 12.0 En
529 11.0 Bl
531 10.9 Ht
531 11.1 En
534 10.5 Sm
538 10.0 Bl
540 10.0 Sm
548 9.4 Bl
550 9.2 En
550 10.8 Ht

RR AQL
195202
564 10.7 Pt
571 10.5 B

RS AQL
195308
567|13.0 B

Nov CYG
195553
559|13.0 Ch
582|12.2 Pt
591|12.2 Pt

Z CYG
195849
555 8.4 Ch
564 8.1 Pt
571 8.9 Sc
585 8.7 B
586 9.2 Sc
591 9.1 Sc

S TEL
195855
524|12.6 En
529 13.0 Bl

SY AQL
200212
527 13.1 An
538 12.4 An
553 11.2 L
559 10.9 Wy
562 10.8 Wy
564 10.1 L
564 10.4 Pt
572 9.4 L
573 9.4 Lg
580 9.1 Gt
580 8.8 An
580 9.0 L
583 9.0 Lg
585 10.4 Pt

J.D.Est.Obs.

BU CYG
200250
552 12.0 Lj
555 12.5 Lj
556 12.5 Lj
567|12.7 Lj

S CYG
200357
559|13.5 Ch

R CAP
200514
559 9.2 Ch
564 9.7 Pt

SV CYG
200647
571 9.4 Sc
586 9.3 Sc
591 9.4 Sc

S AQL
200715a
527 10.4 An
538 8.4 An
555 9.8 Ch
560 9.9 Br
561 9.9 Br
564 10.1 Pt
565 11.1 Lg
568 10.2 Br
572 10.3 B
579 10.6 Br
580 11.4 An
580 11.4 Gt
581 10.7 Br
582 11.6 Lg

RW AQL
200715b
564 9.2 Pt
565 8.9 Lg
572 9.3 B
582 9.0 Lg

R TEL
200717
531 13.1 Bl
538 12.0 Bl
549 10.3 Bl

RU AQL
200812
557 14.2 L
568 14.0 L
573|13.5 Lg
580 13.7 L
583 13.6 Lg

W CAP
200822
531 12.7 Bl
538 12.3 Bl
549 11.9 Bl
564 12.0 Pt

J.D.Est.Obs.

Z AQL
200906
527 12.1 Bf
535 13.1 Bg
545 13.8 Bf
564 13.0 Pt

R SGE
200916
572 9.4 B

RS CYG
200938
547 7.2 Ch
548 7.2 Ch
550 7.2 Ch
551 7.1 Ch
552 6.9 Ch
553 7.2 L
554 6.8 Ch
555 6.8 Ch
556 6.9 Ch
558 7.0 Ch
559 6.9 Ch
560 7.0 Ch
564 7.2 L
564 6.8 Pt
570 7.2 Ch
571 7.2 Sc
572 7.1 L
580 7.3 L
586 7.5 Wd
586 7.3 Sc
586 7.8 Sb
587 7.0 Sp
587 7.2 Jo
588 7.4 Gb
591 7.3 Sc
597 8.0 Sb

R DEL
201008
522 8.4 Be
522 8.5 An
535 9.0 An
552 9.4 Ah
553 9.4 L
555 9.7 Ch
556 9.8 Ah
557 9.9 Ah
561 9.8 Wy
564 9.9 L
564 10.2 Pt
566 9.9 Ah
572 10.2 An
572 10.2 Gt
572 10.1 L
580 11.1 L
587 11.2 Wy

RT CAP
201121
564 7.0 Pt

J.D.Est.Obs.

SX CYG
201130
564 11.2 Pt
567 10.2 B

RT SGR
201139
527 10.4 Bl
538 10.1 Bl
542 9.6 Dr
549 8.8 Bl
552 8.4 Dr
556 8.1 Dr
564 7.5 Dr
564 7.4 Dw

T CYG
201437b
553 11.8 L
559 11.3 Ch
564 11.9 L
564 11.3 Pt
567 11.4 B
572 11.6 L
580 11.5 L
587 11.3 Sp

U CYG
201647
548 9.6 Ch
564 9.0 Pt
570 9.8 B
587 9.8 Jo
587 10.9 Sp

U MIC
202240
527 11.3 Bl
538 11.4 Bl
542 10.8 Dr
549 11.4 Bl
552 11.5 Dr
564 12.1 Dr
564 12.1 Dw

RW CYG
202539
522 9.2 Be
522 9.4 An
535 9.5 An
561 9.6 An
571 9.4 Sc
572 9.2 Gt
572 9.4 An
586 9.4 Sc
591 9.5 Sc

RU CAP
202622
527|14.1 Bf
535|14.5 Bg
545|13.1 Bf

Z DEL
202817
564 10.1 Pt
581 9.4 B

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J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs. J.D.Est.Obs.

ST CYG
202954
561 12.8 Wy
564 13.5 Pt
566 13.0 B
586 13.1 Wy

V VUL
203226
564 8.8 Pt

R MIC
203429
531 12.8 Bl
538 11.2 Bl
549 10.5 Bl

Y DEL
203611
573 12.8 Lg
581 13.5 B
583 12.4 Lg

S DEL
203816
552 11.2 Lj
555 11.2 Lj
557 11.1 Lj
567 10.4 Lj
569 10.2 Lj
577 9.7 Lj
581 9.1 B
582 9.0 Pt

V CYG
203847
553 11.6 Ch
563 10.7 B
582 13.0 Pt

Y AQR
203005
527 10.9 Bf
527 11.1 An
535 10.6 Bg
538 11.0 An
545 10.8 Bf
555 10.6 Ch
563 11.0 Lg
580 11.1 An
582 11.0 Lg
583 10.8 Pt
587 10.8 Sb
595 11.4 Sb

T DEL
204016
523[13.3 An
538[13.3 An
553[13.3 Ch
572[12.8 Gt

V AQR
204102
555 9.4 Ch
583 9.5 Pt

W AQR
204104
527 13.1 Bf
535 12.7 Bg
545 13.8 Bf
552 13.0 L
565 13.5 L
574 13.8 L

U CAP
204215
527 11.3 Bl
538 11.7 Bl
549 12.0 Bl
573 12.8 Lg

V DEL
204318
563[14.0 Lg
573[13.5 Lg
582 13.9 Lg

T AQR
204405
527 13.6 An
538 13.8 An
555 11.8 Ch
565 10.9 Lg
571 10.7 Sb
580 9.7 An
582 9.7 Lg
583 9.4 Pt
587 9.6 Sb
595 9.2 Sb

RZ CYG
204846
566 13.6 B
583 12.7 Pt

S IND
204954
531 13.3 Bl
555 14.5 Dw
555 14.4 Dr

X DEL
205017
581 12.7 B
583 13.2 Pt

RR CAP
205627
542 10.3 Dr
552 10.6 Dr
556 11.1 Dr
564 11.6 Dr
564 11.8 Dw

R VUL
205923a
554 10.4 Ch
562 11.3 Wy
583 12.5 Pt
585 12.0 B
586 12.8 Wy

RS CAP
210116
525 8.3 An
538 8.5 An
580 8.5 An

V CAP
210124
528 10.5 Bl
538 11.0 Bl
549 11.6 Bl
552 12.0 Dr
564 12.7 Dw
564 12.7 Dr

TW CYG
210129
581 12.9 B

X CAP
210221
531[12.7 Bl

X CEP
210382
567 13.7 B

RS AQR
210501
553 14.0 L
565 13.8 L
567 13.5 B
574 13.1 L

Z CAP
210516
527 11.9 Bf
535 12.8 Bg
567 13.6 B
583 13.5 Pt

R EQU
210812
527 11.1 Bf
535 11.6 Bg
545 11.5 Bf

T CEP
210868
547 6.2 Ch
552 5.8 Ah
555 6.4 Ch
556 5.8 Ah
557 5.7 Ah
562 6.5 Sw
566 6.0 Ah
568 6.2 Ah
570 6.2 Ah
571 6.3 Ah
571 6.2 B
572 6.4 Ah
573 6.5 Sb
573 6.4 Wd
582 6.7 Sb
586 6.7 Wd
586 6.5 Pt
587 6.7 Jo
589 7.0 Sb

T CEP
210868
591 7.0 Sc
596 7.4 Sb

RR AQR
214247
523[12.9 Ht
531[13.7 Bl
537[12.9 Sm
550[12.9 Ht
555 14.9 Dw
555 14.7 Dr

V PEG
215605
567 12.9 B
586 13.0 Pt

U AQR
215717
586 10.9 Pt

RT PEG
215934
563 10.3 B
586 11.3 Pt

RY PEG
220133a
586 9.1 Pt
587[12.2 Gi

RZ PEG
220133b
554 9.8 Br
560 9.8 Br
561 9.8 Br
568 9.8 Br
575 9.8 Br
579 9.8 Br
581 9.8 Br

T PEG
220412
553 14.4 L
565 14.4 L

Y PEG
220613
535[14.4 Bg
550[14.8 Bg
566[13.2 B

RS PEG
220714
535 14.3 Bg
550 14.4 Bg
566 13.2 B

X AQR
221321
535 9.1 Bg

T GRU
221038
524 9.6 En
526 9.2 Sm
532 9.2 En
537 8.9 Sm

S GRU
221048
523[12.8 Ht
526[12.8 Sm
532[12.8 En
537[12.8 Sm
550[12.8 Ht
555 14.6 Dw
555 14.3 Dr

RV PEG
222129
566 13.4 B

S LAC
222439
525 12.7 An
535 11.6 An
553 10.8 L
565 10.0 L
572 9.4 Ch
574 9.6 L
580 9.0 An
581 8.9 B
586 8.2 Pt

R IND
223867
528 10.7 Bl
538 10.6 Bl
542 9.9 Dr
549 9.2 Bl
552 9.2 Dr
556 9.1 Dr
564 8.6 Dr
564 8.6 Dw
569 8.8 Dr

T TUC
223462
523 12.8 Ht
526 12.8 Sm
531 13.0 Ht
551 13.0 Ht
555 13.6 Dw
555 13.5 Dr

R LAC
223941
554 12.6 L
565 11.9 L
572 11.5 Ch
574 11.6 L
586 9.9 Pt

RW PEG.
225914
535 12.9 Bg
550 13.7 Bg
581[13.4 B

R PEG
230110
534 10.6 Kl
569 12.3 Sf
572 12.5 Ch
582 12.5 Lg

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J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.	J.D.Est.Obs.
R PEG	W PEG	Z AND	R AQR	RR CAS	R CAS
230110	231425	232848	*233815*	235053	235350
583 12.5 Sp	572 10.5 Ch	586 9.6 Dw	525 9.1 En	551 10.8 Ch	552 6.7 Ah
586 12.4 Pt	572 10.1 An	586 9.5 Pt	530 9.1 An	558 11.4 Bn	556 6.8 Ah
V CAS	572 10.1 Gt	ST AND	531 9.0 Ht	563 11.5 B	557 6.6 Ah
230759	580 11.0 Gt	233335	534 9.0 Sm	592[12.0 Kz	566 6.6 Ah
552 9.4 Ah	580 11.1 An	528 8.6 Bl	539 9.2 An	R PHE	568 6.7 Ah
556 9.3 Ah	582 10.8 Lg	538 9.1 Bl	540 9.0 Sm	*235150*	570 6.6 Ah
557 9.3 Ah	587 10.9 Gi	549 8.6 Bl	550 9.1 Ht	552 11.4 Dr	571 6.7 Ah
562 9.3 Sw	S PEG	551 10.8 Ch	551 9.0 Ch	564 12.1 Dw	572 6.6 Ah
566 9.0 Ah	231508	563 10.4 Lg	555 9.0 L	564 12.0 Dr	580 7.1 B
568 9.0 Ah	586 12.8 Pt	582 11.2 Lg	567 9.1 L	V CET	586 7.5 Wd
571 8.8 Ah	V PHE	586 11.0 Pt	569 9.0 Lg	*235209*	Z PEG
580 7.8 B	*232746*	590 11.5 Kz	574 9.0 L	528 11.5 Bl	235525
586 7.8 Pt	523[13.2 Ht	R AQR	580 9.2 An	531 11.3 Bl	586 12.8 Pt
592 8.0 Kz	526[13.2 Sm	*233815*	586 8.9 Pt	538 11.6 Bl	W PEG
W PEG	533[13.2 Sm	492 8.7 Rj	591 8.8 Sc	549 12.4 Bl	*235715*
231425	550[13.2 Ht	495 8.6 Rj	Z CAS	552 12.7 L	495 9.5 Rj
525 9.2 An	555 14.1 Dw	496 8.7 Rj	233956	567 13.3 L	SV AND
534 9.4 Kl	555 14.0 Dr	497 8.7 Rj	563 12.5 B	R TUC	235939
535 9.4 An	Z AND	498 8.7 Rj	570 13.2 Lg	*235265*	586 12.1 Pt
539 9.6 Kl	232848	504 8.6 Rj	RR CAS	525[12.9 En	586 12.4 Bw
563 9.9 Lg	551 9 9 Ch	523 9.0 Ht	235053	534[12.9 Sm	590 12.3 Kz
	575 9.6 Dw		545 11.2 Bn	540[12.9 Sm	

RAPIDLY VARYING IRREGULAR VARIABLES.

Star J.D. Est.Obs	J.D. Est.Obs.	Star J.D. Est.Obs.	J.D. Est.Obs.
005840 RX ANDROMEDAE—		060547 SS AURIGAE—	
5563.7 11.5 Pt	5586.5 11.5 Pt	5580.6[13.3 L	5587.7[13.3 Gi
5564.7 11.5 Pt	5587.5 11.2 Pt	5581.7[13.9 L	5589.5[12.4 Pt
5571.7 11.6 Pt	5589.5 11.2 Pt	5582.8[14.1 Lg	5590.5[12.4 Pt
5582.6 12.4 Pt.	5590.5 11.7 Pt	5583.6[12.4 Wy	5591.6[12.6 Pt
5583.5 13.0 Pt	5591.6 12.4 Pt	5586.5[12.6 Pt	
010884 RU CEPHEI—		074922 U GEMINORUM—	
5552.7 8.9 L	5568.7 8.8 L	5532.5 13.5 Bf	5568.6 13.8 L
5555.6 8.9 L	5569.6 8.7 L	5549.5 14.0 Bf	5569.6[13.7 L
5556.6 8 9 L	5571.6 8.7 L	5552.6 13.7 L	5570.6 13.9 L
5557.6 8.9 L	5575.7 8.7 L	5554.6 13.7 L	5572.7 13.9 L
5565.3 8.8 L	5579.6 8.7 L	5555.6 13.7 L	5573.7[13.7 Gi
060547 SS AURIGAE—		5556.6 13.7 L	5575.7 13.9 L
5532.5[15.2 Bf	5567.3 10.7 L	5557.6 13.8 L	5577.9[12.3 Pt
5549.4[14.5 Bf	5567.6 11.3 B	5558.6 13.8 L	5586.7[12.3 Pt
5552.3[13.3 L	5568.3 10.9 L	5561.7 13.9 L	5589.9[12.4 Pt
5553.2[12.4 Ch	5569.6 11.2 L	5562.0 14.0 Lg	5590.9[12.4 Pt
5554.4[14.5 L	5569.6 11.4 Sf	5566.7[13.7 L	5591.6[12.4 Pt
5555.4[15.0 L	5570.3 11.7 L	5567.7 13.9 L	
5556.3[13.9 L	5570.9 12.8 Lg	081473 Z CAMELOPARDALIS—	
5557.2[13.9 Ch	5571.1 12.6 L	5552.3 11.0 L	5565.3 12.8 L
5558.6[14.5 L	5571.2 11.4 Ch	5553.2 11.0 L	5567.2 13.1 L
5559.2[13.9 Ch	5571.6 12.3 B	5554.2 11.0 L	5568.2 12.6 L
5561.6 11.4 L	5572.2 12.3 Ch	5555.2 11.6 L	5569.3 10 9 L
5561.9 10.8 Lg	5572.3 12.4 L	5556.3 11.8 L	5570.2 10.8 L
5562.4 10.7 L	5572.6 12.9 B	5557.4 11.7 L	5571.2 10.7 L
5564.3 10.7 L	5573.3 13.5 L	5558.6 12.3 L	5571.4 10.2 Ch
5564.7 10.7 Pt	5573.7 12.4 Pt	5559.7 12.4 L	5572.3 10.7 L
5564.7 10.8 Sf	5574.6 14.2 L	5561.7 12.6 L	5573.3 11.4 L
5565.3 10.7 L	5575.7 14.1 L	5562.4 12.8 L	5574.2 11.8 L
5566.6 11.0 L	5577.9[12.4 Pt	5564.3 12.4 L	5575.7 12.2 L

RAPIDLY VARYING IRREGULAR VARIABLES.

Star	J.D.	Est.	Obs	J.D.	Est.	Obs.
081473 Z CAMELOPARDALIS—						
	5576.3	12.0	L	5580.3	12.9	L
	5577.4	12.7	L	5581.7	12.3	L
	5579.6	12.8	L			
094512 X LEONIS—						
	5552.6	12.9	L	5567.7	12.1	L
	5554.7[	13.9	L	5568.6	12.2	L
	5555.6[	13.0	L	5569.6	12.8	L
	5556.6[	14.0	L	5570.6	12.2	L
	5557.6[	14.5	L	5571.7	12.1	L
	5558.6[	13.9	L	5572.7	12.1	L
	5559.7[	13.0	L	5574.6	12.5	L
	5561.7[	13.8	L	5575.6	14.1	L
	5562.6[	13.0	L	5579.6[	12.8	L
	5565.6[	13.8	L	5580.7[	13.3	L
	5566.7[	13.8	L	5581.7[	14.0	L
202946 SZ CYGNI—						
	5563.7	9.5	Pt	5583.5	8.8	Pt
	5564.7	9.4	Pt	5586.5	8.9	Pt
	5571.7	8.8	Pt	5587.5	8.9	Pt
	5573.7	9.2	Pt	5589.5	9.0	Pt
	5574.5	9.2	Pt	5590.5	9.6	Pt
	5577.5	9.7	Pt	5591.5	9.7	Pt
	5582.6	8.9	Pt			
213843 SS CYGNI—						
	5497.9	11.8	Wk	5554.2	11.4	L
	5508.9	9.1	Wk	5555.2	11.8	Lj
	5521.3	11.9	An	5555.3	11.7	L
	5522.3	11.9	Be	5556.2	12.0	Ch
	5522.3	11.8	An	5556.3	11.9	Li
	5525.3	11.8	An	5556.3	11.7	L
	5526.9	11.6	Wk	5557.2	11.8	Ch
	5527.3	11.3	An	5557.3	11.9	Lj
	5530.4	11.9	An	5557.4	12.0	L
	5535.3	11.5	An	5557.9	11.8	Wk
	5538.3	11.9	An	5558.2	11.9	Lj
	5539.3	11.9	An	5559.1	11.9	Ch
	5552.2	11.7	Lj	5560.2	12.1	L
	5552.3	11.7	L	5561.3	12.0	An
	5553.1	11.9	Ch	5561.8	11.6	Lg
	5553.2	11.6	L	5561.9	11.9	Wk
213843 SS CYGNI—						
	5562.4	12.1	L	5573.2	9.8	Lj
	5562.8	11.8	Lg	5573.2	9.4	L
	5563.6	11.9	B	5573.6	9.0	B
	5563.7	11.6	Pt	5573.6	9.0	Sf
	5563.8	11.8	Lg	5573.7	9.0	Pt
	5564.3	11.9	L	5573.8	8.4	Lg
	5564.7	11.9	Sf	5574.2	8.7	L
	5564.7	11.6	Pt	5574.5	8.5	Pt
	5565.2	11.7	L	5574.5	8.5	B
	5565.8	11.8	Lg	5574.6	8.3	Sf
	5566.3	12.0	Ah	5576.3	8.5	L
	5566.4	12.2	L	5576.8	8.3	Lg
	5566.6	11.8	Sf	5577.2	8.5	Lj
	5566.6	11.8	B	5577.3	8.5	L
	5567.2	11.8	Lj	5577.5	8.6	Pt
	5567.2	11.5	L	5578.2	8.7	L
	5567.6	11.7	B	5579.2	8.7	L
	5568.2	11.6	L	5580.2	8.7	L
	5568.3	11.9	Lj	5580.3	8.3	An
	5568.5	11.6	Ah	5580.6	8.6	B
	5569.2	11.7	Lj	5581.2	8.2	Gt
	5569.3	11.5	L	5581.3	8.2	An
	5569.7	11.8	Lg	5581.6	8.5	B
	5570.2	11.4	L	5582.6	9.0	Pt
	5570.2	11.8	Lj	5582.7	9.4	Lg
	5570.6	11.6	B	5583.5	8.9	Pt
	5570.8	11.6	Lg	5583.6	8.5	Sf
	5571.1	11.8	Ch	5583.7	8.9	Lg
	5571.2	11.8	Lj	5585.6	9.3	B
	5571.2	11.4	L	5586.5	9.6	Sf
	5571.5	11.8	Ah	5586.5	9.2	Pt
	5571.6	11.7	B	5587.5	9.4	Pt
	5571.7	11.5	Pt	5587.5	10.0	Sf
	5571.8	11.7	Lg	5587.5	9.9	Sp
	5572.2	11.4	L	5589.5	10.0	Pt
	5572.2	11.6	Ch	5589.6	10.4	B
	5572.3	11.4	An	5590.5	11.5	Pt
	5572.3	11.7	Gt	5591.5	11.5	Pt
	5572.6	11.2	B	5592.5	11.3	Sf
	5572.8	11.7	Lg			

SUMMARY FOR MONTH ENDING DECEMBER, 1928.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	26	114	Ensor	En	44	78
Ancarani	An	36	89	Ford	Fd	2	9
Baldwin	Bl	89	198	Gaebler	Gb	5	5
Bappu	Bf	24	38	Gallanti	Gt	14	15
Bashkaran	Bg	13	16	Guiler	Gi	12	13
Benini	Be	7	11	Houghton	Ht	35	79
Beyer	Br	8	38	Jones	Jo	5	5
Bigelow	Bw	20	25	Kohl	Kl	8	15
Bouton	B	67	84	Kurtz	Kz	11	11
Brown	Bn	3	5	Lacchini	L	65	338
Chandra	Ch	117	156	Leiner	Lj	11	60
Dartayet	Dr	58	165	Logan	Lg	38	107
Dawson	Dw	40	50	Peltier	Pt	173	250

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Rajchl	Rj	6	41	Spears	Sp	16	18
Rowley	Rw	2	4	Swanson	Sw	8	9
Schoenfeld	Sc	19	32	Waterfield	Wf	1	5
Smith, F. W.	Sf	18	37	Webb	Wd	9	15
Smith, W. H.	Sm	44	92	Whitney	Wy	29	48
Soberanes	Sb	11	26				
				Totals	37	397	2401

January 8, 1929. LEON CAMPBELL, Recording Secretary.

METEOR NOTES.

By CHARLES P. OLIVIER.

During the past month so many more observations of the Leonid shower of last November have arrived that this paper will be wholly devoted to them. It is a matter of regret that lack of space forbids the giving of detailed results which have come in from several observatories. However, an attempt will be made to condense the data into a form which will make them available for theoretical work. As very many of these reports were submitted to Harvard College Observatory directly and not to the A.M.S., it is due to the kind coöperation of Dr. Harlow Shapley and Dr. W. J. Fisher that they have been temporarily turned over to me for inclusion in this report. Due credit must therefore go to these two gentlemen and Harvard College Observatory for the submitting of these data. Table I contains the material directly sent to the A.M.S., Table II, that which came through Harvard. The writer has turned all dates into (old) astronomical time to conform with our custom.

TABLE I.

R. A. MCINTOSH, Auckland, New Zealand.

1928	N.Z.M.T.	Min.	L	S	T	F
Nov. 8	2:05 to 2:50	45	0	5	5	0.6
13	2:05 to 3:25	80	1	15	16	1.0
14	2:00 to 3:15	75	0	9	9	1.0
			1	29	30	

All of these 30 meteors were mapped.

LON MCGIRK, JR., El Monte, California.

1928		Total	
Nov. 15	15:00 to 15:30	7	All but 2 seen in N.E. quadrant.
	15:30 to 16:00	12	One very brilliant, 3 brilliant.
	16:00 to 16:40	14	Times of appearances given.
		33	

YERKES OBSERVATORY, Williams Bay, Wisconsin. Chas. D. Higgs, Y. C. Chang, Wm. W. Morgan. Clear, high wind. F = 0.9.

1928		L	S	T	
Nov. 14	12:23 to 14:10	28	20	48	2 observers, Leonids plotted only.
	14:05 to 14:35	14	9	23	} in N.E. and S.E. Counts only.
	15:05 to 15:35	18	0	18	}
	17:00 to 17:15	40	0	40	in N.E. Counts only.
		100	29	129	

All Leonids seen at high altitudes were bluish.

TEXAS OBSERVERS.

1928			Min.	L	S	T	F
Nov. 10	Brown at Burleson	11:48 to 17:00	312	1	20	21	1.0
	Monnig at Burleson	11:50 to 17:00	310	2-4		49	1.0
	Bunch at Springtown	10:05 to 17:40	444	22	35	57	1.0
	Roach at Springtown	10:05 to 17:40	455			56	1.0*
	Logan at Dallas	12:03 to 15:33	180	2	37	39	1.0
	Sanders at Springtown	10:05 to 17:35	450	16	41	57	1.0
Nov. 17	Bunch at Ft. Worth	12:30 to 15:55	185	12	31	43	1.0
	Mrs. Bunch at Ft. Worth	13:36 to 15:55	139	3	14	17	1.0
Nov. 19	Bunch at Ft. Worth	13:30 to 16:18	168	7	28	35	0.7
						374	

*counts only

Out of the 374 observed, 288 were plotted. A number of duplicate observations were made on Nov. 10 from which heights of Leonids and other meteors should be derivable. Several radiants will be deduced also from this excellent series. Clouds prevented observations on intermediate dates.

TABLE II.

OBSERVATORIO ASTRONOMICO NACIONAL, Tacubaya, Mexico. Dr. Joaquin Gallo, José Chacón, José T. R. Neri, Antonio Solano.

1928		T	
Nov. 13	14:00 to 14:30	13	Some very brilliant, one observer to each quadrant on this and succeeding nights.
	14:30 to 15:00	13	
	15:00 to 15:30	6	
		32	
Nov. 14	14:00 to 14:30	17	Some very brilliant. Many from Orion and Gemini.
	14:30 to 15:00	11	
	15:00 to 15:30	23	
	15:30 to 16:00	20	
	16:00 to 16:30	14	
		85	
Nov. 15	13:00 to 13:30	26	At 14:18 a brilliant Leonid left a train enduring 10 minutes.
	13:30 to 14:00	9	
	14:00 to 14:30	29	
	14:30 to 15:00	31	
	15:00 to 15:30	25	
	15:30 to 16:00	40	
	16:00 to 16:30	19	
		179	
Nov. 16	14:00 to 14:30	16	Sky half cloudy; cloudy at 16^h
	14:30 to 15:00	23	All times used are 7^h W.
	15:00 to 15:30	15	
	15:30 to 16:00	11	
		65	
Totals for four nights:		361	

PENNY FARMS, FLORIDA. Rev. Robert G. Harbutt.

1928 Nov. 15, observed from 11:00 to dawn, with partly clear sky, but without making definite counts. Reports he saw "into the hundreds." From 14:00 to 14:30 at least 12 very brilliant Leonids, including a wonderful fireball. Two Leonids left trains of 3 and 5 minutes duration.

WASHBURN COLLEGE, Topeka, Kansas. Mrs. Helen W. Were and 40 observers.
[Note: This most excellent and complete report covers 5 typewritten pages. It is only possible here to give the most condensed outline of results.]

1928		L	S	T	F	
Nov. 10	10:00 to 11:00	3	9	12		2 obs.
	11:00 to 17:00	131	178	309		4 obs., covering 4 quadrs.
		26	53	79		Several obs., duplicates.
11	10:00 to 12:00	35	52	87		4 obs., covering 4 quadrs.
	12:00 to 17:00	136	173	309		4 obs., covering 4 quadrs.
		53	55	108		Several obs., duplicates.
12	10:00 to 12:00	21	84	105		4 obs., covering 4 quadrs.
	12:00 to 17:00	36	95	131		4 obs., covering 4 quadrs.
		20	39	59		Several obs., duplicates.
14	10:00 to 12:00	39	54	93		4 obs., covering 4 quadrs.
	12:00 to 17:00	205	210	415	0.8	4 obs., covering 4 quadrs.
		74	49	123	0.8	Several obs., duplicates.
		779	1051	1830		

Nov. 13, 15, 16, and 17 cloudy. Apparently these were all counts, no mention is made of plotting.

SMITH COLLEGE, Northampton, Massachusetts.

1928		L	S	T	F		
Nov. 13	8:30 to 9:00	1	0	1	1.0	N.E.	Alice Eberly
15	9:00 to 9:30	2?	1	3	1.0	S.W.	Alice Eberly
13	8:30 to 9:00	1?	0	1	1.0	S.W.	Joan Getchell
13	8:30 to 9:00	0	1	1	1.0	N.W.	Virginia Rowland
13	8:30 to 9:00	1	0	1	1.0	S.E.	Carol Smith
10	10:30 to 11:00	0	1	1	1.0	S.E.	Marjorie Williams
13	10:30 to 11:00	0	3	3	1.0	N.E.	Marjorie Williams
13	11:30 to 12:00	0	6	6	1.0	S.E.	Marjorie Williams
15	15:30 to 16:00	5	1	6	0.7	N.E.	Marjorie Williams
		10	13	23			

SMITH COLLEGE OBSERVATORY, Northampton, Massachusetts. Miss Harriet W. Bigelow. E.S.T. used.

1928		L	S	T	F	
Nov. 10	12:30 to 13:00	0	3	3	1.0	N.E.
11	12:30 to 14:00	1	2	3	1.0	N.E.
	16:00 to 16:30	1	3	4	1.0	N.E.
13	11:00 to 11:30	0	4	4	1.0	N.E.
	12:30 to 13:00	1	3	4	1.0	N.E.
15	12:30 to 12:55			0	0.3	N.E.
17	12:30 to 14:00	1	1	2	0.7	S.E.
		4	16	20		

PINE MANOR SCHOOL, Wellesley, Massachusetts. Miss V. Gushee and 8 observers.

1928		L	S	T	F	
Nov. 11	16:30 to 17:00	3	2	5	1.0	N.W. Miss V. Gushee
	16:30 to 17:00	1	2	3	1.0	S.W. Miss H. M. Gushee
13	7:30 to 8:00	4	7	11	1.0	Whole sky, 6 observers
	8:00 to 9:30	4	4	8	1.0	S.W., 2 observers
15	13:00 to 14:00	9	6	15	0.7	N.E. Miss V. Gushee
	13:00 to 14:00	6	6	12	0.7	S.E. Miss J. Rodgers
				46		

Three fireballs, 2 Leonids, on November 15.

HIRAM COLLEGE, Hiram, Ohio. Prof. E. H. Clarke and 3 observers.
1928 Nov. 14 17:00 to 17:30 E.S.T. 39 L 7 S 46 Total. F = 1.0.
7 Leonids left notable trains.

SOUTH HADLEY, MASSACHUSETTS. L. Ewalt, A. Farnsworth, M. Hughes, M. Miller, C. Stillman.

1928		L	S	T	F
Nov. 10	12:03 to 12:30	1	2	3	0.7
11	7:00 to 9:30	5	10	15	1.0
13	7:30 to 11:00	3	13	16	1.0
15	7:30 to 12:00	4	3	7	0.8
	12:00 to 13:00	7	7	14	0.4
17	14:00 to 14:30	2	3	5	0.7
		22	38	60	

NORWAY, MAINE. Stephen B. Cummings.

1928		T	F
Nov. 9	8:50 to 9:25	2	1.0
10	6:55 to 7:15	1	1.0
13	7:05 to 7:30	0	
14	7:15 to 7:35	0	1.0
15	8:00 to 8:45	1	1.0
		4	

MARIA MITCHELL OBSERVATORY, Nantucket, Massachusetts.

1928		L	S	T	F	
Nov. 14	10:00 to 10:45			4		Miss M. Norcross.
15	10:50 to 11:40			1		Miss M. Norcross.
15	16:00 to 16:30	12		12		Miss M. Harwood and 3 obs.
	16:30 to 17:00	8	1	9		Miss M. Harwood and 3 obs.
				26		

WAITT'S MOUNT, Malden, Massachusetts. Frank L. Hall.

1928		L	S	T	F
Nov. 13	13:00 to 13:30	1	6	7	
	13:30 to 14:00	1	4	5	
	14:00 to 14:30	1	5	6	
				18	

CAMBRIDGE, MASSACHUSETTS. Dr. W. J. Fisher.

1928		L	S	T	F
Nov. 11	16:07 to 16:30	0	2	2	1.0
	16:30 to 17:00	0	1	1	1.0
13	16:30 to 17:00	0	1	1	0.4
15	16:00 to 16:30	4		4	0.4
	16:30 to 17:00	6		6	0.4
				13	

A preliminary study of this report combined with the one published last month leads to some interesting conclusions. It seems that stations in North America were favored very differently as to the number of Leonids seen. This further did not depend wholly upon either the atmospheric conditions or the experience of the observers. Judging by data at hand, observers in the Atlantic States had worst luck. This not only applies to fainter meteors which might be missed due to poorer skies, but to the very bright meteors and fireballs which could not have been overlooked had they appeared at all. The one set of observations from the Southern Hemisphere, by McIntosh at Auckland, New Zealand, proves he saw only one Leonid on the three nights he observed, in each case during the hour or more preceding dawn. Of course the Leonid radiant was very low in his sky. Reports from England, in the December "Observatory," show that a medium number of

Leonids were seen, but that their average brightness was most remarkable—a fact noted in America but perhaps not so pronouncedly. A large number of fireballs were also reported from ships at sea during the middle part of November. The opinion is therefore confirmed that the Leonids furnished us with a far better display than was expected so far in advance of their probable maximum.

We welcome into the American Meteor Society the following:

Bond Astronomical Club, Cambridge, Massachusetts.
Millard Bennett, 3131 S. Calhoun St., Fort Wayne, Indiana.
John J. Conboy, 615 B Ave., Lawton, Oklahoma.
Mrs. W. H. Edwards, Old Spanish Trail, Fairhope, Alabama.
Ned Onstatt, 1424 Carterett Ave., Pueblo, Colorado.
C. W. Taft, Box 866, 25 South St., New York, N. Y.

Persons interested in amateur astronomy are asked to write to the author of these notes if they would like to join in the work of the A.M.S.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1928 January 19.

Meteor Observed.—The day (October 13, 1928) had been drizzly with fog from about 9:00 A.M. to 2:00 P.M. and was still cloudy during the evening. As I was retiring at $10^h\ 16^m$ P.M., Eastern Standard Time, a brilliant light which I at first thought was lightning (although there was no indication of an electrical storm) attracted my attention. As I was at the window I naturally looked out to see it and at once realized that it was an extraordinarily brilliant meteor. I could see it along part of its course through thin clouds and the end of its course was seen in a bit of almost clear sky. After the meteor was spent its train persisted for several seconds and was bright enough to be seen through the clouds and as Vega, Deneb, Altair, and Alpha Ophiuchi could just be seen through thin clouds I was able to get a fair estimate of the positions of the beginning and ending points of the meteor trail. The beginning point was about R.A. $20^h\ 06^m$; Decl. $+2°$ and the ending point about R.A. $18^h\ 15^m$; Decl. $0°$. The light was so bright that it lighted up the whole landscape as a long and vivid flash of forked lightning does, the only difference being that the light persisted for several seconds instead of for only an instant as it does from lightning. The meteor seemed to end with a blaze of light which was distinctly reddish—it looked like an intensely brilliant reddish star. I only saw it in nearly clear sky then and the rest of the path was seen rather by the persistence of its train lighting the cloud along its course, at least that is the way it appeared to me. There was no noise and no appearance of an explosion at the end. It is hard to estimate the apparent brightness of so brilliant a meteor appearing in an almost totally dark and cloudy sky but it seemed to me to light the landscape as brilliantly as the full moon and it was much more brilliant than any meteor I have ever seen before. I have on several occasions seen meteors a little brighter than Venus at its brightest but this one was incomparably more brilliant than that.

My position was 42° 28′.2 N. Lat., $5^h\ 05^m\ 54^s.1$ West Long., and the date and time Oct. 13 at $10^h\ 16^m$ P.M. E.S.T. or Oct. 14 at G.C.T. $3^h\ 16^m$.

SAMUEL L. BOOTHROYD.

Ithaca, New York.

Meteorite Found.—Although the number of meteors which come within the earth's atmosphere is very great, it is rather rare that any trace of them is

found on the earth's surface. Therefore the following account communicated by Paul J. Hogan from Buenos Aires is interesting and important:

> Concordia,* November 15. In the early hours of yesterday a peculiar phenomenon occurred near the Isthilart station, some 30 kilometers to the north.
>
> Approximately at 7:30 A.M. an aerolite fell on the Santa Maria ranch, owned by Don Domingo Isthilart. The celestial mass, coming from the north, traversed space with enormous velocity to the accompaniment of loud explosions which were clearly heard by residents of Federacion, distant some five leagues (approximately 28 km).
>
> Among the inhabitants of the place the unusual event gave rise to a feeling of terror, especially to a farm hand who was plowing at the time when the meteorite fell in the immediate vicinity, and who simultaneously took flight to the ranch-house. Various persons immediately left for the spot indicated by the peon, who thought the explosion was that of a bomb.
>
> The meteorite was discovered at the point indicated and at a depth of 40 cm below the surface. The mass, still hot, was brought to the ranch house and later to Concordia by train today. It is now in the possession of Señor Isthilart. The weight is 3 kilograms and the volume small. Surely, due to the violence with which it struck earth, it has broken in two since one part is very bright in color, contrasting with the dull bronze which predominates; also this bright section is granulated and presents somewhat the appearance of asbestos, whereas the rest of the surface is smooth. In addition it can be easily seen that there is on one side a vein of metal with the appearance of gold or copper.

COMET NOTES.

By G. VAN BIESBROECK.

COMET 1929 *a* (SCHWASSMANN-WACHMANN). The first unexpected comet of this year has just been announced. It was found at the Bergedorf Observatory near Hamburg (Germany) by the same team of observers who had discovered comet 1927 *i* two years ago, a faint object which is still in reach of large telescopes. The first announcement gave the following information:

Magnitude 11 1929 Jan. 17.9319 $5^h\,40^m\,32^s$ $+20^\circ\,30'$
Daily motion: 28^s west and $3'$ south.

The comet was therefore slowly moving near the star ζ Tauri and well placed for observation.

Two days later the object was seen here with difficulty with the 12-inch telescope. The moon was then not far from the object, and the comet was seen as a hazy patch of light without sharp nucleus. But its position was measured as follows on a short exposure taken with the 24-inch reflector:

Jan. 20.03374 $5^h\,39^m\,47^s.19$ $+20^\circ\,35'\,27''.1$ Magnitude $11\frac{1}{2}$.

Later in the same night another plate was exposed after the moon had set and this showed a coma some $30''$ in diameter which extends in position-angle 80° (nearly opposite to the direction of the sun) into a short tail visible over $1'$ in length. There was no stellar nucleus and the central condensation was so diffuse

*Concordia is in the Province of Entre Rios and on the Uruguay River approximately at Lat. 31° 40′ S.

that sharp settings were difficult. The same night the comet was observed by Burton at the Naval Observatory, Washington:

Jan. 20.1915 $5^h\ 39^m\ 42^s.9$ $+20°\ 35'\ 54''$ Magnitude 12.

It occurred to me that this object might well have been recorded on previous plates taken by Messrs. Ross and Zug at the Bruce telescope especially with the wide angle 3-inch Ross camera. By scrutinizing the available material I soon located the new visitor on three such plates taken before the discovery. The scale being small and the object far from the center of the plates, the measures are somewhat uncertain:

Jan. 4.2335	$5^h\ 48^m\ 34^s.7$	$+19°\ 54'\ 53''$
7.1375	46 31.5	20 1 43
Jan. 12.1326	5 43 22.4	+20 14 10

But on account of their early date they are of value, and they enabled us to find, without waiting for further measures, what path the object is describing in space. Starting from the positions January 4, 12, and 20, which happen to be equally spaced at 8 days intervals, an ideal arrangement, an orbit was computed on January 21 by the writer with the help of Mr. Y. C. Chang. The following result was wired January 22 to the central bureau at the Harvard College Observatory for further distribution:

ELLIPTIC ELEMENTS OF COMET 1929 *a*.

Perihelion date	T = 1929 April 1.3595	
Node	Ω = 126° 36.1	1929
Inclination	i = 3 38.7	1929
Longitude of perihelion	ω = 2 15.2	1929
Perihelion distance	q = 2.0304 A.U.	
Eccentricity	e = 0.4358 (Period 6.83 years)	

EPHEMERIS.

1929 0^h U.T.	α h m s	δ ° ′	Δ	r	Mag.
Jan. 28	5 38 16	+20 58.6	1.259	2.092	11.6
Feb. 1	38 21	21 10.6			
5	39 1	21 22.7			
9	40 17	21 34.9			
13	42 7	21 47.1	1.364	2.065	11.7
17	44 3	21 59.0			
21	47 33	22 10.6			
25	51 4	22 21.8			
Mar. 1	5 55 4	+22 32.2	1.497	2.046	11.9

The magnitude is taken as $11^M.5$ on the date of the discovery.

While our computations were being finished, information was received telegraphically that also at the Harvard Observatory images of the comet had been found on plates taken before the discovery. The positions for 1928.0 are as follows:

1928 Dec. 19.2289	$6^h\ 1^m\ 29^s.5$	$+19°\ 22'\ 34''$	12^M
1929 Jan. 9.1148	5 45 12.4	20 6 33	12

The very early observation in December gave an independent check on our work. The residuals in the sense observation minus computation are:

in right ascension: $-3^s.9$ in declination: $-1'.0$

showing that although preliminary our results will require only small changes to fit all the measures.

Fig. 1 illustrates the course of the comet around the sun during the first part of the year. The respective positions of the earth and the comet are marked for the first of each month. The orbit of the earth is represented by a circle while that of the comet is seen as an arc of a large ellipse on which the comet is nearest to the sun on April 1.

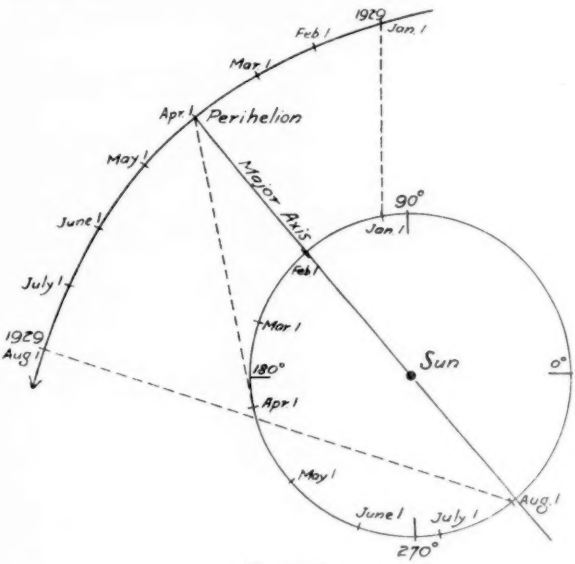

FIGURE 1.

It will be seen that although the comet is now getting nearer to the sun, the increased distance from the earth produces a slow decrease in the theoretical brightness. The large minimum distance of about two astronomical units from the sun next April makes it certain that the comet will not show much physical development.

It has been said recently that observers in the northern hemisphere were not exploring the sky for comets as assiduously as those in the southern hemisphere. From the present case it would seem that astronomers on this side of the equator were too busy photographing the sky for spending additional time in hunting directly for comets!

Another recent instance further rehabilitates the northern observers, namely the case of COMET 1928 *c* (FORBES). It appears from a letter addressed to Professor A. O. Leuschner and dated Mizusawa (Japan) Dec. 17, that Mr. M. Yamasaki has observed this comet independently as early as October 27.81 U.T. in the position:

$11^h\,1^m \quad +8°\,32'$ (*Harvard Announcement Card* No. 81).

"Until November 10, cloudy weather and the moon interfered with further observations, when the object could no longer be found in the foregoing position. Having identified the object as a comet, Mr. Yamasaki notified the Tokyo Observatory. While Mr. Kinoshita of the Tokyo Observatory and Mr. Yamasaki

were still searching for the object, the former photographically, under unfavorable weather conditions, announcement of the discovery of Forbes comet was received in Japan."

Mr. Leuschner finds that the position given corresponds closely to that of Forbes comet and therefore there can be no doubt about the identity of the objects. If Mr. Yamasaki had been less cautious about announcing an unconfirmed object it would have been credited to the northern observers.

Since last month with more observations available from both hemispheres, more accurate orbits have been established. The deviation from a parabolic motion is now such that it is possible to infer the length of the period from this apparition alone. Two independent determinations give the result:

T =	1928 Nov. 4.9016	Nov. 5.02378
ω =	195° 59′ 43″	196° 0′ 13″.6
Ω =	250 9 17 (1928.0)	250 5 19.1
i =	28 54 59	28 54 6.1
ϕ =	67 53 20	67 48 54.2
Log. q =	9.872528	9.872345
Period in years =	32.280	31.9448

The first set computed at Berkeley by H. Thiele and kindly forwarded by air-mail to the writer by Professor A. O. Leuschner depends on a number of observations between November 21 and December 10. The residuals show that owing to the diffuse appearance of the comet the measures scatter more than usual, but the result is nevertheless very close to the second set obtained by A. C. D. Crommelin from a somewhat shorter material. (*British Astr. Assoc. Circ.* No. 68, Dec. 29.) The most interesting feature indicated by these elements is that the true period is apparently one-half of the 55-year interval resulting from the 1818 and 1873 apparitions. Crommelin further notices that therefore a comet observed in 1457 by Toscanelli and in China is probably the same object.

It has been a rule to designate a comet by the names of its several independent discoverers. If the rule is adhered to in this case we should call this one comet Toscanelli-Pons-Coggia-Winnecke-Yamasaki-Forbes!

Photographic observations of the two very faint comets 1927 *d* (STEARNS) and 1927 *i* (SCHWASSMANN-WACHMANN) are still being continued mainly at the Bergedorf and Yerkes Observatories. The magnitudes are respectively 16 and 17. The former comet passed conjunction with the sun about January 1, and will from now on be somewhat better situated in the morning sky.

Williams Bay, Wisconsin, January 23, 1929.

NOTES FROM AMATEURS.

Notes on the Total Eclipse of the Moon, November 27, 1928.

The total eclipse of the moon on the morning of November 27 was observed with the naked eye and with a 6-inch reflector, power 55X. During the early evening the sky was almost entirely overcast, wind moderate from the NW, and temperature about 30° F.

During the period of total eclipse the sky was clear with the exception of some clouds near the eastern horizon. The wind was light from the NW, and the temperature slightly below freezing. The moon was reasonably bright, even at

mid-eclipse, and the greater part of the disc was of a dirty reddish brown color. The northern edge of the disk was much brighter than the rest of the moon, the line between this bright crescent and the dull part being quite distinct to the naked eye, but hard to trace in the telescope. As the moon emerged from the umbra, the intense brightness of the eastern edge made all the rest look dark, and the bright northern crescent was lost.

At no time during the total eclipse was the moon's disk of a uniform brightness, the appearance being almost that of a partial eclipse.

Shortly after the end of totality light clouds drifted across the moon, giving a very beautiful effect, the crescent moon being apparently turned upside down and very blunt (as it sometimes is in inaccurate pictures), and surrounded by a silver halo.

HUGH G. BOUTELL.

3723 Jocelyn St., N. W., Washington, D. C.

The undersigned made observations of the eclipse of the moon on November 27 with the hope of obtaining the time of contacts as closely as possible. However, of course in a lunar eclipse one can not get the results as close as is desired. Clouds hampered the observations considerably, so that only poor results for beginning of totality were obtained. The results for ending of totality I believe were good.

E. S. T.

At $2^h\,23^m8$ the moon was to enter the umbra (*American Ephemeris*).

This was observed as having occurred at $2^h\,24^m\,34^s$, but as somewhat heavy clouds covered the moon at that time, the results are believed too late.

The sky was clouded from 2:30 to 4:00 A.M. so completely that the moon was not visible.

Totality was to have ended at $4^h\,29^m3$ (*American Ephemeris*).

Totality was observed to end at $4^h\,29^m\,23\frac{5}{8}^s$.

For the above observations a fine stop watch (graduated to fifths of a second) was used. This was put through a series of exhaustive tests immediately preceding the eclipse in comparing it with our Molyneux clock which was then within a tenth of a second of being correct. The clock is kept in a stone pier with constant temperature.

DONALD B. PRENTICE.

178 Doyle Avenue, Providence, Rhode Island.

The total eclipse of the moon of November 27, 1928, was observable here under fairly favorable conditions. The moon entered penumbra about 1:25 A.M., our time, but as far as I could see with the naked eye there was little apparent change in the light given out. This observation was slightly interfered with by light clouds from time to time. About 2:20 A.M. the beginning of the umbra could be noticed in southeast portion of the moon's surface. This spread rapidly over the surface until about 3:15, only a beautiful crescent was left, the remaining portion of the surface being of a reddish color. By 3:30 only a very small thin crescent was still visible and about 3:40 the total stage began. The clouds were beginning to get thicker but from time to time the clear sky was visible. The total phase was only visible for about ten minutes before the clouds shut out the view completely. During this time the greater part of the surface was of reddish color which did not appear to be steady but changed from a blood red to a coppery red.

This was probably due to the unsteadiness of the atmosphere and some of the lighter clouds. The side which was bright the longest still retained a whitish color and the opposite side was almost black. Unfortunately the middle of the total phase and all the latter part of the eclipse were not visible on account of the clouds. Although this eclipse left much to be desired because of the clouds, it was the best that I have seen in the last twenty years although it occurred at a very inconvenient hour.

GORDON MCFARLANE.

490 Cooper St., Ottawa, Ontario, Canada.

Observing Society at Moscow.—Recently a considerable increase in the number of astronomical observations made by the amateur astronomers of Russia may be noted. In Moscow in the Society of Amateur Astronomers for seven years there has existed the Observing Society which has at the present time nearly 100 members. The observers' chief attention is given to meteors, variable stars, and planets. In studying the meteoric showers the observations of their physical characteristics are the most numerous. It is to be noted that this branch of meteoric astronomy began to develop only in modern time. Owing to the unfortunate conditions, the main part of variable stars observed by the members of the Observing Society consists of the bright stars, but even so the number of observations collected is rather large, as can be seen from the following table:

Observations of Variable Stars	45.000
Observations of Meteors	6,000
Observations of the Sun	4.300
Observations of the Moon and Planets	500

In 1922 the members of the Observing Society noted the different brightness of two parts of Saturn's ring. The east part of the ring during the year 1922 remained $0^{M}.2$ brighter than the west one. Later Professor Fessenkoff observed this effect and gave the difference in brightness of the same order. The discussion of observations of Jupiter showed that the width of its bands depends on the activity of the sun. An interesting phenomenon (Karrington's phenomenon) was observed on September 15, 1926. It consisted of a quick movement of photosphere over the large sun-spot. This effect seems to be observed for the first time in several years.

All results of observations done by the members and by the collaborators of the Observing Society, as well as different articles on astronomy and astrophysics are published in *Bulletin of the Observing Society*, which has appeared three or four times each year since 1925.

One of the principal aims of the Observing Society is the study of different errors of observations and the determination of the best methods of discussion of observations done collectively.

In general, articles are accompanied by abstracts in English, French, or German. The Observing Society would be glad to co-ordinate its work with other Associations and persons who are specially interested in the observations mentioned above. The scientific correspondence should be addressed to the President, B. Vorontsov-Velyaminov, Moscow, Solianka 1, 86.

GENERAL NOTES.

Colonel F. J. M. Stratton, secretary of the International Astronomical Union, has been elected as Professor Newall's successor with the title of Professor of Astrophysics in Cambridge University and Director of the Solar Physics Observatory.

Astronomy by Radio. — Dr. O. L. Dustheimer, professor of Mathematics and Astronomy, Baldwin-Wallace College, Berea, Ohio, is giving another series of Astronomical Radio Talks over WTAM, Cleveland, Ohio. These lectures are given on every other Tuesday evening at 10:30 E.S.T. The complete program follows: January 15, The Meaning of Time; January 29, The Zeiss Planetarium; February 12, Forecasting the Weather; February 26, Jupiter, The Giant Planet; March 12, Variable Stars; March 26, Star Names; April 9, Twin Stars; April 23, The Astronomer.

SS Aurigae. — Variable star observations recently received indicate that the peculiar variable star SS Aurigae, 060547, has undergone variations of a sort not heretofore noted for this star. Three maxima have been observed, December 10 (mag. 13.1), December 28 (mag. 12.0), and January 5 (mag. 12.3), none of which has reached normal maximum brightness, usually of magnitude 11.0. Neither has the star reached normal minimum magnitude during the same interval of time. This behavior is similar to that of SS Cygni, 213843, during the years 1907 to 1909. Frequent observations, both visual and photographic, are desired.

Harvard College Observatory, Announcement Card 80. January 18, 1929.

The Barnard Astronomical Club.—A club composed of amateur astronomers and others interested in astronomy has recently been organized in Nashville, Tennessee, former home of the late Dr. Edward Emerson Barnard. In honor of this distinguished astronomer the club has chosen for its name "The Barnard Astronomical Club."

Meetings are held once a month at the observatory of Vanderbilt University. Through the courtesy of Professor James McClure of the faculty the use of Vanderbilt's 6-inch Cooke refractor is permitted those attending the meetings. With this telescope several comets were discovered by Dr. Barnard when he was in charge of Vanderbilt Observatory. The meetings are open to the public and talks on astronomical subjects are given. Mrs. Roberta Dillon Lyne is president of the club. The five meetings held thus far indicate a growing interest in popular astronomy.

LATIMER J. WILSON.

Franklin, Kentucky.

Zodiacal Light Observations.

On November 14, 2:20 to 2:40 A.M., the writer observed the Zodiacal Light. Width on eastern horizon, about 15°; thence the Light was well defined through Leo and Cancer to the Galaxy. Beyond the Galaxy the Gegenschein was seen bordering the Pleiades on the west until lost in the glare of Jupiter. Beyond Jupiter a faint Zodiacal band extended to the horizon in Pisces. The contrasting darkness of the sky in the ∧-shaped angle formed below the Zodiacal Light and the Galaxy (in Canis Minor) was strikingly marked. One Leonid was noticed

issuing from the Sickle with a S.W. course. On the morning of November 27 at 4:00 A.M., during the totality of the lunar eclipse, the Zodiacal Light was again observed extending from the eastern horizon to the meridian. The same contrasting darkness between the Zodiacal band and the Galaxy was noted. Also a very brilliant meteor was seen at 4:15 with a direct N.W. course from the Sickle. On December 9 at 9:00 P.M., a faint, diffuse, Zodiacal band was observed extending from Jupiter to the western horizon, a reminder that the evening Zodiacal Light will be well placed for observation during the winter and spring. The Gegenschein will also repay observation during January as it passes through Gemini into Cancer. Reports of observations are requested. In response to his request, information concerning methods of reporting Zodiacal Light observations has been sent to Professor John Maclean, Wilson College, Bombay, India, for the use of a selected group of students there.

W. E. GLANVILLE.

The Rectory, New Market, Maryland.

Relativity Extended. — The degree to which the popular interest in science has advanced in recent years is indicated by the prominence given by the metropolitan newspapers to a recent contribution by Professor Albert Einstein. A brief paper consisting of seven typewritten pages submitted to the Prussian Academy of Sciences has again brought the name and work of this great German scientist prominently before the public. Professor Einstein, although greatly annoyed by such publicity, having been urged by newspaper reporters to do so, has issued the following statement concerning his recent conclusions, as given in the *Philadelphia Inquirer* for January 12, 1929:

> "I hate nothing more than publicity over scientific work. I cannot explain to you wherein the importance of my work lies. These things are so remote to the average layman that it would be impossible to give any review of them to anyone except to scientists specially acquainted with this sphere of scientific knowledge.
>
> "I have only recently presented my work to the academy. Under no circumstances should I like to pass any opinion about the value of my work. Whether the thoughts contained in it will be fruitful, will only be seen later.
>
> "My new work is nothing but a mathematical continuation of my old work about the theory of relativity. I have made comparisons that may be interpreted as a fusion of the field laws of gravitation and electricity.
>
> "My work is actually about seven pages long, and is the result of about ten years' searching. It is of such nature that only scientists can understand it."

BOOK REVIEW.

The North American Almanac for 1929.— The North American Almanac Co., Chicago, Ill.

The copy of this almanac for 1929, the ninth in the series, is at hand. It contains 160 pages of interesting and instructive reading matter. In addition to the usual information concerning sunrise and suset, the same for the moon, and other material traditionally found in almanacs, there are fifty-five other brief articles ranging from "Do Plants Really Eat" to "Hail Factories in the Sky." Among the contributors of these articles are many whose names are well known in scientific and educational circles. The reader may feel, therefore, that, in general, he will be learning facts and not fiction from this volume. A careful student might, however, find fault with a statement here and there, some on page 58 for example. On the whole the book is a useful one to have at hand.